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Accelerate Your Troubleshooting

Agilent oscilloscopes are designed to help you accelerate the troubleshooting process. Based on input from customers around the world, Agilent has engineered features and unique capabilities that will enable you to keep pace with the rapid changes in technology, yet are easier to use than most competitive products. The result is you spend more time troubleshooting your design and less time fighting your oscilloscope.

- Real-time oscilloscopes with bandwidths from 20 MHz to 13 GHz
- Sampling oscilloscopes with bandwidths up to 80 GHz
- Unique mixed signal scopes with integrated oscilloscope and logic analysis features
- MegaZoom technology for fast and deep memory all the time

Agilent Offers a Wide Range of Oscilloscopes

Model	Bandwidth	Sample Rate	Analog Channels	Digital Channels	Memory Depth
Handheld U1600A Series	20 – 40 MHz	200 MSa/s	2	—	125 Kpts
Economy DSO3000 Series	60 – 200 MHz	500 M – 1 GSa/s	2	—	4 Kpts
Portable DSO5000 Series	100 – 500 MHz	2 – 4 GSa/s	2 or 4	—	1 Mpts standard
High Performance Portable MSO/DSO6000 Series	100 MHz – 1 GHz	2 – 4 GSa/s	2 or 4	16 optional	Up to 8 Mpts (2 Mpts standard)
Low Profile Scope DSO 6000L Series	100 MHz – 1 GHz	2 – 4 GSa/s	4	16 optional	2 Mpts standard
Mainstream Lab Infiniium 8000 Series	600 MHz – 1 GHz	2 – 4 GSa/s	4	16 optional	Up to 128 Mpts (8 Mpts standard)
High Performance Lab Infiniium DSO80000B Series	2 GHz – 13 GHz	20 – 40 GSa/s	4	—	Up to 2 Mpts at 20 G – 40 GSa/s
High Bandwidth Sampling 86100C Infiniium DCA-J Series	3 GHz – 80 GHz	40 kS (sequential)	4	—	Configurable

- **3-in-1 solution: 2-channel oscilloscope, true RMS DMM, data logger**
- **Large 4.5-inch LCD color display**
- **Up to 200 MSa/s real time sampling rate**
- **125 KB/channel memory depth**
- **Zoom and Dual Waveform Math functions (includes FFT function for U1604A)**



U1602A

U1604A

The Agilent U1600A Series digital handheld oscilloscopes include two models: the U1602A with 20 MHz bandwidth and U1604A with 40 MHz bandwidth. The U1600A Series is designed to address portability in multi-industrial automation, process control, facility maintenance and automotive-service industries. Bringing value and high performance, it was voted the No. 1 Product of the Year by readers of *Elektronik*, one of Europe's key electronics magazines.

Clearly Distinguish your Waveforms

Clearly distinguish the waveforms between channels with U1600A's large 4.5-inch, 320x240 resolution LCD color display.

Effective Capture and Precise Isolation of Signals

With real-time sampling rates up to 200 MSa/s, you can achieve effective capture of signal anomalies, deviations and glitches. The U1600A Series deep memory of 125 KB enables capture of non-repeating signals over long time spans, and zooming into the segment of interest to uncover even the most subtle details of the signal. Advanced triggering types such as edge, pulse width, pattern and video, further enable quick isolation of critical events.

Quick Waveform Analysis with FFT and Dual Waveform Math Functions

Add and subtract multiple channel signals with U1600A's Dual Waveform Math function. With the U1604A's Fast Fourier Transform (FFT) function, you can view waveforms in four windowing techniques: Rectangular, Hanning, Hamming, and Blackman-Harris.

22 Automatic Measurements

Make and display four different measurements simultaneously with up to 22 automatic measurements.

Save and Recall Waveform and Setup Memories

Save/recall up to 10 waveforms and configuration setups at anytime so you can save test time. As an option, you can also store your waveforms and setups onto a USB flash drive through the instrument's USB host port.

Built-in DMM Functions

The U1600A Series can function as a 6000 count resolution, true RMS digital multimeter (DMM) with a broad range of measurement functions – including voltage, resistance, capacitance, diode, continuity test and temperature measurements.

Built-in Data Logger Function

The U1600A Series comes with a standard USB 2.0 full speed interface. This, together with the bundled PC Link application software, enables remote control and data transfer to PC. With the PC Link application software, you can also perform storing, retrieval and documentation of your data.

Multi-language Quick Help Support

The built-in Quick Help menu is designed to give you instant assistance, and is available in English, German, Italian, Spanish, Portuguese, French, Korean, Traditional Chinese, Simplified Chinese, and Japanese.

Scope Specifications¹

Vertical System: Scope Channels

Bandwidth (–3 dB)

U1602A: DC to 20 MHz

U1604A: DC to 40 MHz

Scope Characteristics²

Acquisition : Scope Channels

Maximum Sample Rate

U1602A: 200 MSa/s interleaved, 100 MSa/s each channel (50 s/div to 125 ns/div)

U1604A: 200 MSa/s interleaved, 100 MSa/s each channel (50 s/div to 250 ns/div)

Equivalent Sample Rate

U1604A: 2.5 GSa/s (125 ns/div to 10 ns/div)

Vertical Resolution

8 bits

Maximum Memory Depth

125 kilobytes/channel

Peak Detection

5 ns

Average

Selectable in average number of 2, 4, 8, 16, 32, 64, 128, 256

Vertical System: Scope Channels

Analog Channels

Channel 1 and Channel 2 simultaneous acquisition

Rise Time

U1602A: <17.5 ns

U1604A: <8.8 ns

Vertical Sensitivity

5 mV/div to 100 V/div (1:1 scope probe)

50 mV/div to 1 kV/div (10:1 scope probe)

500 mV/div to 10 kV/div (100:1 scope probe)

Maximum Input

CAT III 300 V_{rms} (up to 400 Hz) from terminal to ground

Offset/Dynamic Range

± 5 div

Input Impedance

1 MW || <20 pF

Coupling

AC, DC, GND

Maximum Probe Input

1x CAT III 300 VAC 10x, 100x CAT III 600 VAC

Noise Peak-to-peak

3% of full scale or 5 mV, whichever is greater

DC Vertical Offset Accuracy

±0.2 div ±2 mV ±0.5% offset value

Single Cursor Accuracy

4% full scale

Dual Cursor Accuracy

4% full scale

¹ All specifications are warranted. Specifications are valid after a 30-minute warm-up period and within ±10°C from firmware calibration temperature.

² All characteristics are typical performance values and are not warranted. Characteristics are valid after a 30-minute warm-up period and within ±10°C from firmware calibration temperature.

U1602A
U1604A

Horizontal System

Range

U1602A: 50 ns to 50 s/div
U1604A: 10 ns to 50 s/div

Resolution

U1602A: 2 ns
U1604A: 400 ps

Delay Range (pre-trigger)

15 divisions

Delay Range (post-trigger)

1000 divisions

Analog Δt Accuracy

$\pm 3\%$ reading $\pm 0.4\%$ screen

Modes

Main, XY, Roll

RMS Jitter

5% of horizontal scale or 5 ns whichever is higher

Trigger System

Source

Channel 1 and Channel 2

Modes

Auto, normal, single

Selections

Edge, pulse width, pattern, video

- Edge: Trigger on a rising or falling edge of any source
- Pattern: Trigger at the beginning of a pattern of high, low levels and rising or falling edge established conditions of AND, OR, NOR and NAND between the channels
- Pulse width: 200 ns to 10 s. Trigger when a positive or negative pulse width of any source larger than, less than, equal to or not equal to duration
- Video: Video trigger sensitivity: 0.7 division trigger level. Available to both Channel 1 and Channel 2. Analog progressive and interlaced video standards including NTSC, PAL and SECAM. Positive or negative sync pulse polarity. Modes – all fields, even fields, odd fields or line 5 – 263 within a field

Range

± 4 divisions from center screen

Level Accuracy

± 0.5 divisions

Trigger Sensitivity

DC to 5 MHz: 0.5 divisions

U1602A: 5 MHz to 20 MHz – 1 division

U1604A: 5 MHz to 40 MHz – 1 division

Coupling

DC, AC (<1 Hz), HF reject (>50 kHz), LF reject (<30 kHz), Noise reject

Measurement System

Autoscale

Finds and displays all active scope channels, sets edge trigger mode on highest numbered channel, sets vertical sensitivity on scope channel. Requires voltage >20 mVp-p, 0.5% duty cycle and frequency >100 Hz

Automatic Measurement

Measurements continuously updated

Voltage

Peak-to-peak, maximum, minimum, amplitude, top, base, +overshoot, –overshoot, preshoot, RMS, mean and one cycle mean

Time

Frequency, period, +width, –width and +duty cycle and –duty cycle on any channel

Rise time, fall time, delay and phase shift

Cursors

Manually place readout of horizontal (X, ΔX) and vertical (Y, ΔY)

Waveform Math

CH1 + CH2, CH1 – CH2, CH2 – CH1

FFT¹

Window

Rectangular, Hamming, Hanning, Blackman-Harris

Amplitude Display

Selectable in amplitude display of 1 dB, 2 dB, 5 dB, 10 dB

Digital Multimeter Specifications² \pm (% of reading + % of range)

DC Voltage

Up to 600 V

AC Voltage

Up to 600 V

AC + DC Voltage

Up to 600 V

Resistance

Up to 60 M Ω

Capacitance

Up to 300 μ F

Diode

Up to 1 V

Measurement Characteristics

Full Scale Reading

6000 count

DC Voltage, True RMS AC Voltage

Maximum input voltage, 600 V_{rms} CAT II, 300 V_{rms} CAT III

DC coupled input coupling

Continuity

Beeper <60 Ω in 600 W range

Data Logger

Source

Digital multimeter measurements

Range

10 divisions

Record Size

250 points

Time Span

Auto range 150 seconds to 20 days

Time Reference

Time from start

Record Method

Selectable minimum, maximum and average

Display System

Display

4.5-inch diagonal color CSTN LCD

Resolution

320 x 240 pixels

Control

Contrast control, infinite persistence on/off

Built-in Help System

Functional help displayed by pressing help button

Real Time Clock

Time and date (user adjustable)

Storage

Save/Recall (non-volatile)

Up to 10 setups and traces

Key Literature & Web Link

Data Sheet, p/n 5989-5576EN

For more information on U1600A Series www.agilent.com/find/U1600A

To watch U1600A Series interactive product showcase

www.agilent.com/find/U1600A_showcase

Ordering Information

U1602A 20 MHz Digital Handheld Oscilloscope

U1604A 40 MHz Digital Handheld Oscilloscope

Includes U1560A Scope Probe (1:1), U1561A Scope Probe (10:1), U1571A Ni-MH Battery Pack 7.2 V, 4500 mA, U1580A DMM Test Lead, Ground Alligator Clip, Medium Jaw Alligator Clip, Hook Clip, USB Cable, Power Cord and AC Adapter, Quick Start Guide, Product Reference CD-ROM (includes User's and Service Guide, Quick Start Guide and PC Link Application software), Certificate of Calibration, Test Report

Accessories

U1560A Scope Probe (1:1) CAT III 300 V

U1561A Scope Probe (10:1) CAT III 600 V

U1571A Ni-MH Battery Pack 7.2 V, 4500 mA

U1580A DMM Test Lead

U1590A Soft Casing

U1562A Scope Probe (100:1) CAT III 600 V with ground alligator clip

Option 001 USB Host Capability

¹ FFT function is only available for U1604A model.

² For temperature between 0°C to 18°C and 28°C to 50°C, add 0.1% of reading + 0.02% of range for every degree Celsius.

- Large 15-cm (5.9-in) color display
- Up to 1 GSa/s sample rate and 4 k points of memory
- Advanced triggering including edge, pulse-width, and line-selectable video
- 20 automatic measurements and 4 math functions with FFTs
- USB connectivity and Scope Connect software, standard
- GPIB and RS232 connectivity available
- Mask test standard



Full-featured Oscilloscopes for the Smallest Budgets

Agilent's 3000 Series oscilloscopes give you an affordable way to see what's happening in your designs. Developed with the features you need to make your job easier.

Need flexibility? Choose from four models with bandwidths ranging from 60 MHz to 200 MHz. To give you the debugging power you need, each oscilloscope comes standard with advanced features including sophisticated triggering, automatic measurements, digital filtering, sequence mode acquisition, math functions (including FFTs), stored setups and waveforms, mask testing and much more.

See your Signals More Clearly

All 3000 Series models have color displays to allow you to quickly identify your signals, and the large size – 15 cm (5.9 in) with 320 x 240 resolution – makes it easier for you to see more information.

The 3000 Series' delayed sweep also lets you see more details in your design. You can view a long record, then window in on the section of the signal of interest.

All the Features you Need

All 3000 Series scopes include the standard features you need to get your job done easier and faster:

Autoscale – Autoscale lets you quickly display any active signals, automatically setting the vertical, horizontal and trigger controls for the best signal display.

Advanced Triggering – Includes edge, pulse width and line-selectable video, to help you isolate the signals you want to see.

Waveform Math with FFTs – Analysis functions include addition, subtraction, multiplication, and Fast Fourier Transforms with four windows (Hanning, Hamming, Blackman-Harris and rectangular).

Auto Calibration – Automatically calibrates the oscilloscope's vertical and horizontal systems.

Multi-language Interface – Operate the oscilloscope in the language of your choice. Language support includes simplified and traditional Chinese, Japanese, Korean, French, German, Italian, Portuguese, Russian, Spanish and English.

Digital Filtering – Digital filtering selections include low pass, high pass, band pass, and band reject filters. Limits are selectable between 1 kHz and the bandwidth of your oscilloscope model.

Ten Waveform and Setup Memories – Store waveforms or commonly used setups for future reference and use.

Mask Testing – Automatically compares incoming signals with a pre-defined mask, clearly highlighting signal changes.

Sequence Mode – Frame an area of interest on your signal and record up to 1,000 frames for playback.

3-year Warranty – All 3000 Series scopes include a full 1-year warranty with optional 3-year warranty coverage.

Easy to Set Up and Use – Dedicated, color-coded knobs for vertical sensitivity, offset, and time base settings make it easy to set up and use. Front-panel keys for triggering functions are also grouped to make your job easier.

Specifications

Bandwidth

DSO3062A: 60 MHz

DSO3102A: 100 MHz

DSO3152A: 150 MHz

DSO3202A: 200 MHz

Real Time Sample Rate

2 channels interleaved: 1 GSa/s

Each channel 500 MSa/s

Channels

2

Display

Color, 320 x 240 1/4 VGA LCD; H: 88 mm, W: 116 mm

Memory

4 kpoints per channel

Vertical Resolution

8 bits

Vertical Sensitivity

2 mV/div to 5 V/div

DC Gain Accuracy

±3% for 10 mV/div to 5 V/div; ±4% for 2 mV/div to 5 mV/div

Vertical Zoom

Vertical expand

Maximum Input Voltage

300 V_{rms} CAT II; derated at 20 dB/decade above 100 kHz to 13 V p-p AC at 3 MHz and above

Time Base Range

2 ns/div to 50 s/div (5 ns/div to 50 s/div in DSO 3062A)

BW Limit

~20 MHz

Input Coupling

DC, AC, Ground

Input Impedance

1 MΩ; ≈13 pF

Time Base Accuracy

100 ppm

Acquisition Modes

Normal: Displays sampled data directly to the screen in real time

Averaging: Selectable from 2, 4, 8, 16, 32, 64, 128 or 256

Peak detect: Captures high-frequency glitches as narrow as 10 ns when viewing signals at slower sweep speeds (slower than 5 μs/div)

Sweep Modes

Auto, Normal

Trigger Coupling

AC, DC, LF reject, HF reject

Trigger Modes

Force: Triggers immediately when front-panel button is pushed

Edge: Triggers on the positive or negative slope on any channel

Video: Triggers on one of three standard television waveforms: NTSC, PAL, SECAM

Pulse triggering: Triggers on a pulse width greater than, equal to, or less than a specified time limit, with time limits ranging from 20 ns to 10 s

Trigger Source

Ch 1, 2, Ext, Ext/5, Line (edge mode only)

Cursors

Modes: Manual, auto, track

Type: Time and voltage

Measurements: ΔT, ΔV, frequency

Automatic Measurements

20 plus 5-digit hardware counter

Voltage: Peak-to-peak, maximum, minimum, average, amplitude, top,

base, V_{rms}, overshoot, preshoot

Time: Frequency, period, +width, -width, +duty cycle, -duty cycle, rise

time, fall time, delay, phase

Math Functions

Add, subtract, multiply, FFT

DSO3062A

DSO3102A

DSO3152A

DSO3202A

N2860A

N2861A

N2862A

N2863A

10073C

N2774A

N2775A

10076A

N2771A

Oscilloscopes

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3000 Series Economy Oscilloscopes (cont.)

DSO3062A
DSO3102A
DSO3152A
DSO3202A
N2860A
N2861A
N2862A
N2863A
10073C
N2774A
N2775A
10076A
N2771A

FFT

Window modes: Hanning, Hamming, Blackman-Harris, rectangular
Sample size: 1024 points

Autoscale

Single button automatic setup of all channels

Display

1/4 VGA (320 x 240), passive color LCD with adjustable brightness

Interpolation

Sin(x)/x

Display Types

Dots and vectors

Persistence

Off, infinite

Format

YT and XY

I/O

Optional ports: GPIB, RS-232

Maximum data transfer rates: GPIB: 500 kbytes/sec

Physical Size

30 cm wide x 15 cm high x 29 cm deep (without handle)

34.6 cm wide x 18.2 cm high x 29 cm deep (with handle)

Weight Net

4.8 kgs (10.5 lbs)

Shipping

7 kgs (15 lbs)

Accessories

Accessories Included

Quick Start manual, CD-ROM with User's Guide (French, German, Japanese, Korean, Russian, Simplified Chinese, and English) and Programmer's Manual, power cord, accessory pouch, two passive probes, Scope Connect Software

Additional Probes

N2862A 10:1, 150 MHz passive probe

N2863A 10:1, 300 MHz passive probe

10070C 1:1, 20 MHz passive probe

N2774A 50 MHz current probe, ac/dc

N2775A Power supply for N2774A

10076A 100:1, 4 kV, 250 MHz high-voltage probe

N2771A 1000:1, 15 kV, 50 MHz high-voltage probe

Optional Accessories

N2861A Communications Module

Provides GPIB and RS-232 connectivity and pass/fail output for automatic testing.

Warranty Options

All models include a standard 1-year warranty. Contact your local sales office for prices of extended warranty options.

R-51B-001-3C: 1-year return-to-Agilent warranty, extended to 3-years

Key Literature & Web Link

3000 Series Oscilloscopes Data Sheet, p/n 5989-2235EN

www.agilent.com/find/DSO3000

Ordering Information

DSO3062A 60 MHz, 2 Channel Oscilloscope

DSO3102A 100 MHz, 2 Channel Oscilloscope

DSO3152A 150 MHz, 2 Channel Oscilloscope

DSO3202A 200 MHz, 2 Channel Oscilloscope

N2860A 3000 Series Connect Software

N2861A Communications Module

N2862A 150 MHz Passive Probe

N2863A 300 MHz Passive Probe

10070C 1:1, 20 MHz Passive Probe

N2864A Rack Mount Kit

N2774A 50 MHz Current Probe, ac/dc

N2775A Power Supply for N2774A

10076A 100:1, 4 kV, 250 MHz High-voltage Probe

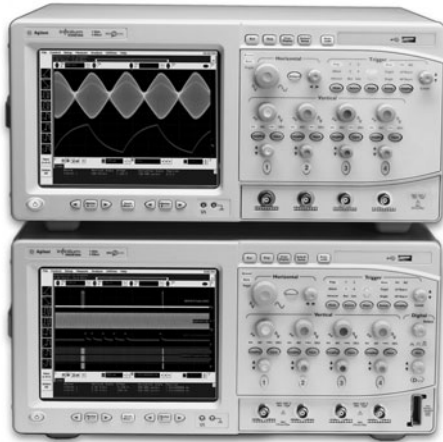
N2771A 1000:1, 15 kV, 50 MHz High-voltage Probe

N2865A USB Host Modules (standard with purchase)

3

- Analog signal viewing with fast and responsive **MegaZoom** memory
- Digital signal triggering and analysis
- Serial triggering and decode for I²C, SPI, CAN, LIN, Flex Ray and more

5000 Series
6000 Series
8000 Series
80000 Series



Analog: Up to 4 Channels with 4 GaS/s Sample Rate and 1 GHz Bandwidth

MegaZoom Technology

MegaZoom deep memory captures long, non-repeating signals and maintains high sample rates, allowing you to quickly zoom in on areas of interest. Sample rate and memory depth go hand-in-hand. Deep memory in oscilloscopes sustains a high sample rate over longer time spans. MegaZoom also supports a high-resolution XGA display system and maps the deep memory to 256 levels of color intensity grades, delivering unmatched real-time insight into signal details.

Signal Integrity – Probing

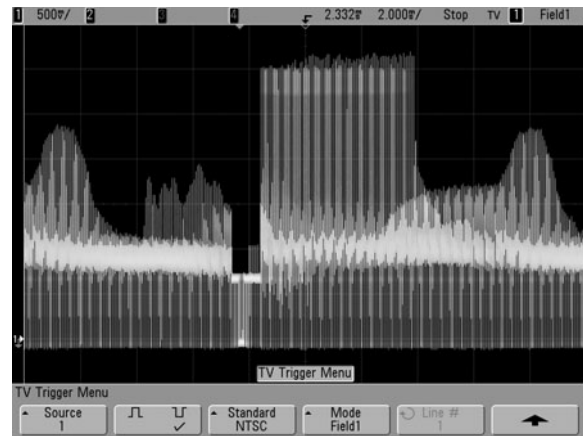
Probing high-frequency signals becomes more challenging as the variety of test points and the frequencies of the signals continue to grow. Probes need to be lightweight, small, affordable, and offer the accessories and probe tips you require to get your job done easily. Agilent has a wide range to meet your needs.

Digital: 16 Digital Timing Channels and Mixed Signal Triggering

With many of today's designs containing a mix of signal types and speeds, it's often critical to capture and compare multiple cycles of digital signals along with slower analog signals. But doing so often requires an instrument that can deliver more resolution and memory than a traditional DSO can provide.

Easily See Complex Interactions with an MSO

Mixed signal oscilloscopes (MSOs) with 2 or 4 scope channels plus 16 logic channels combine the detailed signal analysis of a scope with the multi-channel timing measurements of a logic analyzer.



Full-width Pattern Triggering

Flexible triggering capabilities across all scope and logic channels so you can easily isolate and analyze complex signals in your mixed analog and digital designs.

View Scope – Logic and Scope Correlation

Easily make time-correlated measurements between an Agilent logic analyzer and an Agilent 5000, 6000, 8000 or 80000 Series Scope. Easily view and analyze time-correlated logic and scope waveforms integrated into a single logic analyzer waveform display. Global markers track between two instruments.

Serial: Hardware-accelerated Decode and Trigger for I²C, SPI, CAN, LIN and Flex Ray

As more and more component interfaces move from parallel to serial on both low- and high-speed buses, Agilent is offering more serial triggering and decode options on oscilloscopes.

Serial Bus Triggering and Decoding

Trigger on the industry's most popular serial bus standards including I²C, SPI, CAN, LIN, FlexRay and USB. Decode options display responsive, on-screen decode of serial bus traffic. Select from a suite of hardware triggers for the ability to isolate specific events with pin-point accuracy, then enable decode to validate serial bus activity in real-time.

Hijack Infrequent Errors

Fast acquisition speed combined with hardware-accelerated decoding increases your probability of capturing elusive events. Agilent oscilloscopes can help you catch that intermittent problem before it becomes an intermittent customer complaint or quality concern.

Oscilloscopes

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Oscilloscopes, 100 MHz to 500 MHz 5000 Series Oscilloscopes

MegaZoom
DSO5012A
DSO5014A
DSO5032A
DSO5034A
DSO5052A
DSO5054A

- **1Mpts deep memory – High sustained high sample rates means that you don't lose signal resolution – even when acquiring long periods of time**
- **100,000 waveforms/sec update rate – Fast waveform update rates provide you with unsurpassed ability to capture and view infrequent and intermittent problems**
- **XGA display with 256 levels of intensity – A high-definition display system improves your ability to view small signal anomalies**
- **Full connectivity, including USB: USB, LAN, GPIB, and XGA video-out are all included standard**
- **LXI class C compatible**



Users of general-purpose portable oscilloscopes have, until now, had to work through everyday debug tasks using oscilloscope technology from the 1990s. Engineers need tools capable of handling today's design challenges. The new 5000 Series oscilloscopes tackle these needs with responsive deep memory, a high-definition display system, and a superior ability to capture signal transients. Traditional bench scopes are great for characterizing things that you know about. Agilent's patented deep memory and fast waveform update rate help you find the bugs that you don't know about.

MegaZoom III Deep Memory

Based on the same technology that powers Agilent's market leading high end oscilloscopes the deep memory that is available in the 5000 oscilloscope is based on MegaZoom technology. 1 Mpt of MegaZoom deep memory comes standard so you can capture long, non-repeating signals, while maintaining high sample rates and good timing resolution.

Don't Take our Word for It

Compare the 5000 Series with your current bench scope. View an on-line product demonstration or schedule a hands-on evaluation by visiting our web site at: www.agilent.com/find/5000ct2 This memory updates up to 100,000 times per second, so you can capture intermittent glitches with confidence.

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Specifications

	DSO5012A	DSO5014A	DSO5032A	DSO5034A	DSO5052A	DSO5054A
Bandwidth	100 MHz	100 MHz	300 MHz	300 MHz	500 MHz	500 MHz
Sample Rate	2 GSa/s each channel	2 GSa/s each channel	2 GSa/s each channel	2 GSa/s each channel	2 GSa/s each channel, 4 GSa/s max	2 GSa/s each channel, 4 GSa/s max
Channels	2	4	2	4	2	4
Display	Color, 1024 x 768 6.3" XGA LCD with 265 intensity levels					
Memory	1 Mpts max, 500 kpts each channel					
Update Rate	Up to 100,000 waveforms per second					
Vertical Sensitivity	2 mV/div to 5 V/div					
Maximum Input Voltage	CAT I 300 V _{rms} , 400 Vpk; transient overvoltage 1.6 kVpk; CAT II 100 V _{rms} , 400 Vpk					
Input Impedance	1 MW ± 1% 12 pF or 50 W ± 1.5% selectable					
Timebase Accuracy	25 ppm up to 40°C; 40 ppm at 55°C					
Display Mode	Main, delayed, XY and roll					
Triggering	Edge, Pulse width, Pattern, TV (Composite and HDTV/EDTV), Duration					
Dimensions	38.5 cm W x 18.8 cm H x 17.4 cm D (with handle)					
Weight	4.1 kg					

Accessories

Options

SEC Secure Environment Mode
E2690B Oscilloscope Tools (US/Can)
N5385B Oscilloscope Tools (Int'l)
N2916B Rackmount Kit for 6000 and 5000 Series Oscilloscopes
N2917B Transit Case for 6000 and 5000 Series Oscilloscopes
N2760A Soft Carrying Case for 5000 Series Oscilloscopes

Probes

10073C 10:1, 500 MHz Passive Probe (shipped with DSO605xA)
N2863A 10:1, 300 MHz Passive Probe (shipped with DSO501xA, 503xA)
10070C 1:1, 20 MHz Passive Probe
1130A 1.5 GHz InfiniiMax Differential Probe Amplifier (accessories sold separately)

N2774A 50 MHz Current Probe, AC/DC (requires N2775A power supply)
1146A 100 kHz Current Probe, AC/DC
1147A 50 MHz Current Probe, AC/DC
10076A 100:1, 4 kV, 250 MHz High-voltage Probe
N2771A 1000:1, 15 kV, 50 MHz High-voltage Probe
1141A 200 MHz Differential Probe (requires 1142A power supply)
N2772A 600 V CAT III, 20 MHz Differential Probe (requires 9 V battery or N2773A power supply)

Key Literature & Web link

Visit www.agilent.com/find/5000ct2 to download the following additional information:
 5000 Series Portable Oscilloscopes Brochure, p/n 5989-6385EN
 5000 Series Portable Oscilloscopes Data Sheet, p/n 5989-6390EN
 5000 and 6000 Series Probes and Accessories Data Sheet, p/n 5968-8153EN

Features

	General Purpose		High Performance	
	DSO5000	DSO6000	MSO6000	
Channel	Channel count 2 or 4 analog			
Sample Rate	Maximum sample rate 4 GSa/s			
Display	XGA display, 256 intensity levels, update rate 100,000 wps			
Accessories	Extensive selection of probes and accessories			
Connectivity	USB, LAN, GPIB connectivity, XGA out, LXI Class C compliant			
Bandwidth				
100 MHz	•	•	•	
300 MHz	•	•	•	
500 MHz	•	•	•	
1 GHz		•	•	
MegaZoom Deep Memory				
1 Mpts – standard	•			
2 Mpts – standard		•		
8 Mpts – upgrade		• ¹	• ¹	
Triggering				
Triggering (Edge, Pattern, Pulse, Width, TV, HDTV)	•	•	•	
I ² C, SPI and USB serial bus triggering		•	•	
CAN, LIN and FlexRay serial bus triggering		• ¹	• ¹	
Mixed signal triggering across both analog and digital content		• ¹	•	
Digital Timing Channel				
16 digital timing channels with mixed signal triggering and bus display mode		• ¹	•	
Xilinx and Altera FPGA dynamic probe application options		• ¹	• ¹	
Serial Decode				
I ² C/SPI/CAN/LIN/FlexRay serial bus decode		• ¹	• ¹	
Options				
Battery option		• ¹	• ¹	

¹ Upgrade or pay option available; advanced serial triggering and decode available on 4 channel models.

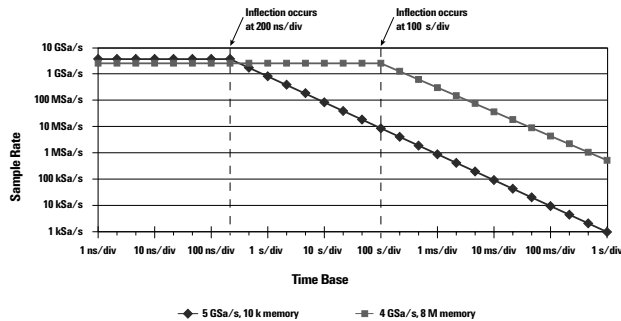
Probe Scope Selection Guide

	GP Portable	High Performance Portable	
	DSO5000	DSO6000	MSO6000
Channel	Channel 2 or 4 analog		
Sample Rate	Max Sample rate – 4 GSa/s		
Display	XGA resolution, up to 100,000 waveforms/sec and 256 levels of intensity scale		
Accessories	Extensive selection of probes and accessories		
Connectivity	Standard USB, LAN, GPIB connectivity, XGA out, LXI class C compliant		
Bandwidth			
100 MHz	•	•	•
300 MHz	•	•	•
500 MHz	•	•	•
1 GHz		•	•
MegaZoom Deep Memory			
1 Mpts – standard	•		
2 Mpts – standard		•	
8 Mpts – upgrade		• ¹	• ¹
Triggering			
Triggering (Edge, Pattern, Pulse, Width, TV, HDTV)	•	•	•
I ² C, SPI and USB serial bus triggering		•	•
CAN, LIN and FlexRay serial bus triggering		• ¹	• ¹
Mixed signal trigger on both analog and digital content		• ¹	•
Digital Timing Channel			
16 digital timing channels with mixed signal trigger and bus mode		• ¹	•
Xilinx and Altera FPGA dynamic probe application option		• ¹	• ¹
Serial Decode			
I ² C/SPI/CAN/LIN/FlexRay serial bus decode		• ¹	• ¹
Options			
Battery option		• ¹	• ¹

¹ There is either an upgrade or for pay option available; advanced serial triggering and decode available on 4 or 4+16 – channel models only.

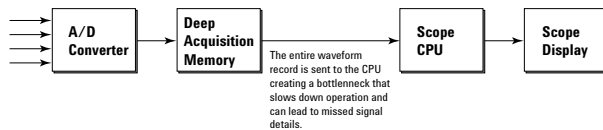
DSO8000
MSO8000

- Instant response to control signals – with up to 128 Mpts of deep memory
- Zoom in quickly on critical signals
- Easily and quickly find infrequent and unpredictable events

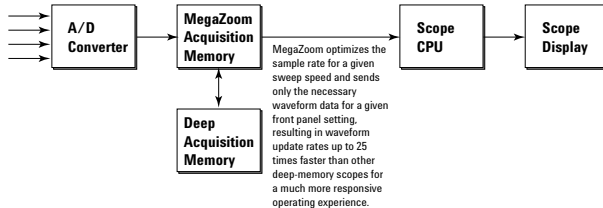


Scope memory affects sample rate.

Conventional Deep-Memory Scope Architecture



MegaZoom Deep-Memory Scope Architecture



Agilent MegaZoom delivers fast, responsive operation through a custom, integrated circuit that optimizes data acquisition and processing.

Always On and Always Fast

With many of today's designs containing a mix of signal types and speeds, it's often critical to capture and compare multiple cycles of digital signals along with slower analog signals. But doing so often requires an instrument that can deliver more resolution and memory than a traditional DSO can provide. MegaZoom gives you memory that is simultaneously fast and deep all the time, unlike deep-memory options on alternative scopes. With Agilent oscilloscopes, you have up to 128 Mpts of MegaZoom deep memory, enabling you to correlate high-speed digital control signals with slower analog signals, capture infrequent events and then quickly zoom in on the details to narrow in on problems. Unlike deep-memory options on alternative scopes, Agilent MegaZoom is not a special mode with sluggish response. It's always on, always fast, and always there to help you capture the most critical signals with maximized sample rates.

Patented Technology

MegaZoom technology is based on a custom processor that controls the flow of data into acquisition memory and rapid post-processing for display and measurements. The MegaZoom processor operates at the full speed of the scope's A/D. Processing the data with MegaZoom technology greatly reduces the amount of data transferred to the scope's CPU for post-processing. MegaZoom substantially increases the waveform update rate and front-panel responsiveness of Agilent's deep memory scopes, making these scopes better suited to working on today's complex digital-based designs. Responsiveness and waveform update rate slow down dramatically on traditional deep memory oscilloscopes making them difficult, sluggish and frustrating to use. Agilent's oscilloscopes feature patented MegaZoom technology that provides the fastest waveform update rates – uncompromised. Agilent oscilloscopes also feature best-in-class waveform viewing powered by MegaZoom technology.

Deep Memory Provides Sustained High Sample Rates

Besides bandwidth, one of the most fundamental specifications in a digital storage oscilloscope (DSO) is its specified maximum sample rate. However, a DSO's sample rate is actually based on the scope's time base setting. At the faster time base settings, all oscilloscopes will capture waveforms using their specified maximum sample rates. But as you adjust the time base setting to slower ranges in order to capture longer waveforms, all scopes will automatically reduce their sample rates because of their limited memory depths. Deeper memory in an oscilloscope means that the scope can sustain its maximum sample rate on more time base settings, enabling you to see more details of your signals.

- Mixed signal oscilloscopes – 16 digital channels time-correlated with traditional scope analog channels
- Oscilloscope interface and ease of use with logic analyzer insight, timing and measurements
- Precise analog measurements timed with exact digital content, all in one box



Agilent pioneered the mixed signal oscilloscope in the mid 1990s and has continued to modify and improve upon the original idea since then. You can now choose from a large selection of bandwidths, memory depths and sample rates to meet your needs.

What is an MSO?

Increasing digital content brought about by the wide use of micro-controllers, DSPs, and microprocessors has added to the challenges of design verification and debug. And the proliferation of low-cost serial buses makes it more difficult to trigger on and interpret the interaction of information as it flows through a system. To trace the path between initial symptom and root cause of a problem with a traditional 2- or 4-channel oscilloscope, you have to take multiple acquisitions to capture all the signals of interest. Each acquisition only gives you a narrow view of system behavior.

Agilent's mixed signal oscilloscopes (MSOs) tightly correlate 2 or 4 analog channels with 16 logic timing channels. MSOs combine all of the measurement capabilities of a digital storage oscilloscope (DSO) with some of the measurement capabilities of a logic analyzer, along with serial protocol analysis – in a single instrument. With an MSO, you are able to see multiple time-aligned analog, parallel, digital, and serially decoded waveforms on the same display. MSOs allow you to trigger on any combination of analog and digital signals – and on many popular serial bus protocols. You can do all of this with a single, easy-to-use oscilloscope interface.

More Channels, More Memory, More Triggering

With the increasing digital content in today's designs, it is often difficult to capture enough channels simultaneously with a traditional 2 or 4 channel scope. To further complicate matters, the analog and digital sides are often operating at drastically different speeds. The seamless integration of scope and logic timing channels in the MSO gives you an instrument with unprecedented capabilities. With the MSO you can trigger on any combination of its scope and logic channels with the low jitter performance you expect from an oscilloscope. Now you can capture, display, and analyze a variety of signals in one acquisition on one instrument screen, helping you narrow in more quickly on tough design problems. With mixed signal scopes, a 16-channel timing analyzer is seamlessly integrated into a full-featured scope. It's now easy to measure a combination of signal types and speeds all at once, including slow analog slow analog, fast digital, or baseband RF.

MSO6000A
MSO8000A

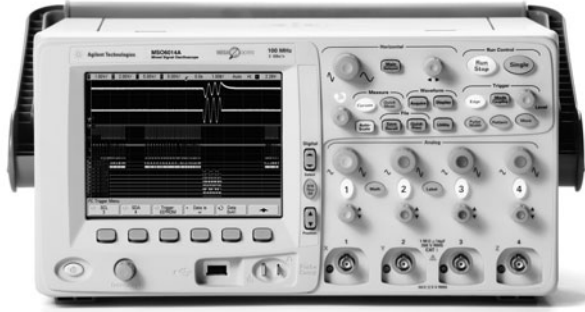
Oscilloscopes

60

6000 Series Portable Oscilloscopes

DSO/
MSO6000
Series

- Choose from Bandwidths ranging from 100 MHz to 1 GHz
- 100,000 Waveforms/sec update rate
- Up to 8 Mpts deep memory – Responsive MegaZoom III deep memory
- Pick the model that best fits your budget



Performance Packed at a Budget Price

These oscilloscopes are ideally suited for testing circuits that are taking advantages of the use of onboard serial data. With bandwidths ranging from 100 MHz to 1 GHz, MegaZoom III deep memory technology, advanced triggering, a high definition display, the look and ease of use of an analog scope, and built-in help, Agilent's 6000 Series oscilloscopes give you a view into your system performance that is unmatched by any other portable oscilloscopes at a price that fits within your budget.

Responsive Deep Memory

MegaZoom technology gives you higher sampling speeds where you need them to observe the wide range of signals in your system, rather than just the faster few sweep speeds. MegaZoom is available at all times and does not require a special operating mode. Measurement data are mapped into a high-resolution XGA color display with 256 levels of intensity and 1000 points resolution, twice the display resolution of other oscilloscopes.

Powerful Triggering

Because of increased digital content in today's electronic circuits, traditional level and slope scope triggering is no longer enough. Agilent's 6000 Series portable oscilloscopes offer a rich triggering feature set that lets you easily isolate and analyze complex signals and fault conditions. Triggers include:

- Pulse width
- TV
- I²C
- SPI
- USB
- LIN*
- CAN*
- FlexRay*

MegaZoom III Technology

The 6000 Series oscilloscopes are based on the third generation of MegaZoom technology. This third generation of MegaZoom enhances the responsiveness of this deep memory technology while maintaining its mode free operation. MegaZoom III provides:

- The most responsive deep memory available
- The highest definition color display available
- Fastest update rate, uncompromised

Available Applications and Options

The 6000 Series oscilloscopes are not only a powerful portable oscilloscope standard in their off the shelf configuration but they also offer a selection of additional options to enhance debugging and decoding of your specific application. From analog signal analysis of vectors and Jitter to digital signal FPGA debugging to serial triggering a decoding of CAN, LIN and FlexRay the 6000 Series oscilloscopes can help you get your job done faster.

Agilent 6000 Series Oscilloscope Selection Guide

	601xA		603xA		605xA		610xA	
	DSO6012A	DSO6014A	DSO6032A	DSO6034A	DSO6052A	DSO6054A	DSO6102A	DSO6104A
	MSO6012A	MSO6014A	MSO6032A	MSO6034A	MSO6052A	MSO6054A	MSO6102A	MSO6104A
Bandwidth	100 MHz		300 MHz		500 MHz		1 GHz	
Channels Scopes	2 or 2 + 16	4 or 4 + 16	2 or 2 + 16	4 or 4+16	2 or 2 + 16	4 or 4 + 16	2 or 2 + 16	4 or 4 + 16
Sample Rate	2 GSa/s		2 GSa/s		4 GSa/s		4 GSa/s	
Maximum Memory	8 Mpts		8 Mpts		8 Mpts		8 Mpts	
Standard Memory	2 Mpts		2 Mpts		2 Mpts		2 Mpts	
Special Features	All of the 6000 Series are supplied with MegaZoom III technology and MSO models incorporate the seamless integration of 16 logic timing channels. All models can be upgraded with additional memory at any time after purchase and all DSO models can be upgraded to an MSO configuration in your lab as an after purchase product.							

* available with purchase of option.

Agilent Portable Oscilloscope Specifications

DSO/
MSO6000
Series

	601xA	603xA	605xA	610xA
Channels	2 (DSO6012A) 4 (DSO6014A) 2 + 16 (MSO6012A) 4 + 16 (MSO6014A)	2 (DSO6032A) 4 (DSO6034A) 2 + 16 (MSO6032A) 4 + 16 (MSO6034A)	2 (DSO6052A) 4 (DSO6054A) 2 + 16 (MSO6052A) 4 + 16 (MSO6054A)	2 (DSO6102A) 4 (DSO6104A) 2 + 16 (MSO6102A) 4 + 16 (MSO6104A)
Scope Channels				
Bandwidth	100 MHz	300 MHz	500 MHz	1 GHz
Max Sample Rate	2 GSa/s	2 GSa/s	4 GSa/s	4 GSa/s
Max Input	400 V dc + peak ac	400 V dc + peak ac	400 V dc + peak ac	400 V dc + peak ac
Resolution	8 bits	8 bits	8 bits	8 bits
High Resolution Mode		12 bits of resolution when $\geq 10 \mu\text{s}/\text{div}$	@ 4 GSa/s or $\geq 20 \mu\text{s}/\text{div}$	@ 2 GSa/s
Vertical Range	1 mV/div to 5 V/div (1 M Ω input)	2 mV/div to 5 V/div (1 M Ω or 50 Ω input)	2 mV/div to 5 V/div (1 M Ω or 50 Ω input)	2 mV/div to 5 V/div (1 M Ω input), 2 mV/div to 1 V/div (50 Ω input)
Max Memory	8 Mpts (optional) 2 Mpts standard	8 Mpts (optional) 2 Mpts standard	8 Mpts (optional) 2 Mpts standard	8 Mpts (optional) 2 Mpts standard
Time Base Range	5 nsec/div to 50/div	2 nsec/div to 50/div	1 nsec/div to 50/div	500 psec/div to 50/div
Peak Detection	1 ns peak detect	500 ps peak detect	250 ps peak detect	250 ps peak detect
Triggering	Internal selection of CH1, CH2, (CH3, CH4) Line and Ext Edge, Pattern, Pulse Width, TV, Sequence, Duration Nth edge and Serial Protocols of I ² C, SPI, USB, CAN, LIN (advanced CAN, LIN and FlexRay available through add-on optional applications)			
Source				
Modes				
Display	High Definition color LCD XGA – 1024 horizontal x 768 vertical, 256 levels of intensity scale			
Type				
Resolution				
Measurements	Peak-to-peak, maximum, minimum, average, amplitude, top, base, overshoot, undershoot, RMS standard duration (AC RMS), frequency, period, +width, –width, duty cycle, time at max, time at min, phase, and delay Built-in 5 digit frequency counter on any channel, counts up to the scope's bandwidth The counter resolution can be increased to 8 digits with an external 10 MHz reference Manually or automatically placed readout of Horizontal (X, deltaX, 1/deltaX) and Vertical (Y, deltaY)			
Automatic				
Counter				
Cursors				
Math Functions	CH1 – CH2, 1*2, FFT, Differentiate, Integrate, sqrt			
Storage	USB 1.1 ports on front and rear panels Waveform images as BMP or PNG and waveform data as CSV, ASCII XY pair or binary			
Type				
Format				
Connectivity	USB 2.0 device, 2x USB 1.1 host, 10/100 Base T LAN, GPIB and Video output			
Built-in Help	Key specific help in 6 languages			
Warranty	1 year, option increase to 5			
Size	35.4 cm W x 18.8 cm H x 28.2 cm D (without handle)			
Net Weight	4.9 kg (10.8 lbs)			

Ordering Information

	601xA		603xA		605xA		610xA	
	DSO6012A	DSO6014A	DSO6032A	DSO6034A	DSO6052A	DSO6054A	DSO6102A	DSO6104A
	MSO6012A	MSO6014A	MSO6032A	MSO6034A	MSO6052A	MSO6054A	MSO6102A	MSO6104A
Bandwidth	100 MHz		300 MHz		500 MHz		1 GHz	
Channels Scopes	2 analog or 2 analog + 16 digital	2 analog or 2 analog + 16 digital	2 analog or 2 analog + 16 digital	4 analog or 4 analog + 16 digital	2 analog or 2 analog + 16 digital	4 analog or 4 analog + 16 digital	2 analog or 2 analog + 16 digital	4 analog or 4 analog + 16 digital
Sample Rate	2 GSa/s		2 GSa/s		4 GSa/s		4 GSa/s	
Maximum Memory	8 Mpts		8 Mpts		8 Mpts		8 Mpts	
Standard Memory	2 Mpts		2 Mpts		2 Mpts		2 Mpts	
Included Accessories	10:1 passive probe per scope (analog) channel, MSO includes a 54620-68701 (2 x 8) logic cable, user guide, service manual, programmer's manual, power cord, accessories storage, front panel cover, one-year warranty, Agilent IO libraries version 14.2 CD							

Memory and MSO Options

Option Number on New Units – Factory Installed	Option Number After Purchase – User Installed	Description	601xA/603xA	605xA/610xA
8ML	N2911A	8 Mpts half channel, 4 Mpts each channel	•	
8MH	N2913A	8 Mpts half channel, 4 Mpts each channel		•
Order MSO model	N2914A	MSO upgrade kit for DSO models (user installed)	•	
Order MSO model	N2915A	MSO upgrade kit for DSO models (user installed)		•

Probe and Accessory Options

1146A 100 kHz/100 A Current Probe, AC/DC
N2772A 20 MHz Differential Probe (Requires N2773A power supply)
10070C 1:1 Passive Probe with ID
10076A 100:1, 4 kV, 250 MHz Probe with ID
N2771A 1000:1, 15 kV, 50 MHz High-voltage Probe
N2780A 2 MHz/500 A Current Probe, AC/DC (Requires N2779A Power Supply)
N2781A 10 MHz/150 A Current Probe, AC/DC (Requires N2779A Power Supply)
N2782A 50 MHz/30 A Current Probe, AC/DC (Requires N2779A Power Supply)
N2783A 100 MHz/30 A Current Probe, AC/DC (Requires N2779A Power Supply)
1147A 50 MHz Current Probe, AC/DC with AutoProbe Interface
1141A 200 MHz Differential Probe (Requires 1142A probe control and power module)
1156A 1.5 GHz Active Probe with AutoProbe Interface
1130A 1.5 GHz InfiniiMax Differential Probe Amplifier with AutoProbe Interface (Requires one or more InfiniiMax probe head – E2675A, E2668A, E2669A)
1144A 800 MHz Active Probe (Requires 1142A power supply)
N2916B Rackmount Kit for 5000/6000 Series Scope
N2917B Transit Case for 5000/6000 Series Scope
1180CZ Testmobile Scope Cart
N2919A Testmobile Bracket for 1180CZ and 6000 Series Scope
N2918A Oscilloscope Evaluation Kit for 6000 Series Scope

Application Options

Digital Analysis

N5406A FPGA Dynamic Probing Xilinx
N5434A FPGA Dynamic Probing Altera

Serial Data Analysis

N5423A I²C/SPI Serial Decode Option (for 4/4 + 16 Ch models only)
N5424A AMS CAN + LIN Automotive Triggering and Decode (4/4 + 16 Ch models only)
N5432A FlexRay Automotive Trigger + Decode FRS

Additional Options

BAT Battery option – operate scope without line power
SEC Secure environment mode option

- 4 channel scope in only 1U (43.6 mm space)
- Up to 1 GHz bandwidth, 4 GSa/s sample rates and 8 M memory
- Built in web browser for control
- Standard USB, LAN, GPIB interfaces and XGA out
- 100% compatible with 6000A Series portable oscilloscopes
- Optimized for automated and manufacturing test
- LXI class C compliant



The Agilent 6014L Series digital storage oscilloscopes (DSOs) offer four channels of measurements in a compact, rack-mountable 1U-high form factor, giving engineers a space-efficient way to integrate oscilloscopes into their test systems.

Powerful Acquisition with MegaZoom III Deep Memory

Consistent with other Agilent oscilloscopes the deep memory that is available in the 6000L Series Low Profile oscilloscope is based on MegaZoom technology. 2 Mpt of MegaZoom deep memory comes standard so you can capture long, non-repeating signals, while maintaining high sample rates and good timing resolution.

Mixed Signal Analysis Option

If you work with both analog and digital circuitry, the Agilent 6000L Series oscilloscope can help you see more signal activity in your designs. You can upgrade the 6000L Series oscilloscope to a 4 scope + 16 logic timing channel mixed signal oscilloscope (MSO). Agilent's mixed signal oscilloscopes (MSOs) tightly correlate 4 analog channels with 16 logic timing channels. With an MSO, you are able to see multiple time-aligned analog, parallel, digital, and serially decoded waveforms on the same display.

Easy System Integration

Rack mount brackets and rack rails are standard with every unit and because the units have side and rear air vents (no top or bottom air vents) other instruments can be mounted directly above or below them. There is built-in web server to provide remote access and control of the instrument via a standard Java-enabled web browser on your computer. There is also a no-cost optional secure environment mode that provides the highest level of security by ensuring that internal memory is clear of all setup and trace settings. Because the 6000L Series Oscilloscope is LXI class C compliant and is 100% compatible with 6000A Series Oscilloscope it enables an easy transition from development to manufacturing. Engineers can use the LXI class C compliant 6000A Series portable oscilloscope during the R&D phase, using the display, keypad and knobs. When your product moves to manufacturing, you can use a system-optimized 6000L Series LXI oscilloscope without a display.

Specifications

	DSO6014L	DSO6054L	DSO6104L
Channels	4 scope channels (16 logic channels available as option)	4 scope channels (16 logic channels available as option)	4 scope channels (16 logic channels available as option)
Scope Channels			
Bandwidth	100 MHz	500 MHz	1 GHz
Max Sample Rate	2 GSa/s	4 GSa/s	4 GSa/s
Max Input	400 V dc + peak ac	400 V dc + peak ac	400 V dc + peak ac
Vertical Resolution	8 bits	8 bits	8 bits
High Resolution Mode (Time Base & Bits of Resolution)	<100 nsec/div, 8 bits 500 nsec/div, 9 bits 2 µsec/div, 10 bits 10 µsec/div, 11 bits ≥50 µsec/div, 12 bits	<100 nsec/div, 8 bits 500 nsec/div, 9 bits 2 µsec/div, 10 bits 10 µsec/div, 11 bits ≥50 µsec/div, 12 bits	<100 nsec/div, 8 bits 500 nsec/div, 9 bits 2 µsec/div, 10 bits 10 µsec/div, 11 bits ≥50 µsec/div, 12 bits
Standard Memory	2 Mpts on 2 channels, 1 Mpts on 4 channels		
Time Base Range	5 nsec/div to 50 sec/div	1 nsec/div to 50 sec/div	500 psec/div to 50 sec/div
Peak Detection	1 ns peak detect	250 ps peak detect	250 ps detect
Triggering	DSO6xx4L: Ch 1, 2, 3, 4, line, ext and D0 – D15 for MSO enabled DSO Edge, Pattern, Pulse Width, TV, Sequence, Duration, Nth edge burst and Serial Protocols of I ² C, SPI, USB (CAN, LIN and FlexRay available through add-on optional applications)		
Source			
Modes			
Display	—	—	—
Measurements	Peak-to-peak, maximum, minimum, average, amplitude, top, base, overshoot, preshoot, RMS, standard deviation (AC RMS), frequency, period, +width, –width, duty cycle, time at max, time at min, time at max, phase, and delay		
Automatic			
Counter	Built-in 5 digit frequency counter on any channel, counts up to the scope's bandwidth The counter resolution can be increased to 8 digits with an external 10 MHz reference		
Math Functions	CH1 – CH2, CH1 + CH2, 1*2, FFT, Differentiate, Integrate		
Connectivity	USB 2.0 device, 2 x USB 1.1 host, 10/100 Base T LAN, GPIB and XGA Video output		
Warranty	1 year, option increase to 3		
Size	43.5 cm W x 27 cm D x 4.2 cm H (without brackets)		
Net Weight	Net: 2.45 kg (5.4 lbs.) Shipping: 6.2 kg (13.6 lbs.)		

Key Literature & Web link

Agilent Technologies 6000L Low Profile Oscilloscopes Data Sheet, p/n 5989-5470EN
 Agilent Oscilloscope Probes and Accessories Selection Guide, p/n 5989-6162EN
 Agilent 6000 Series Oscilloscopes Data Sheet, p/n 5989-2000EN/EUS
 Agilent 5000 and 6000 Series Oscilloscope Probes and Accessories Data Sheet, p/n 5968-8153EN
 Option SEC N5427A Secure Environment Mode Option Data Sheet, p/n 5968-5558EN
 Next-Generation Test Systems Application Note, p/n 5989-2802EN
 LXI: Going Beyond GPIB, PXI and VXI Application Note, p/n 5989-4371EN
 Optimizing Test Systems for Highest Throughput Lowest Cost and Ease of Integration with LXI Instruments Application Note, p/n 5989-4886EN
 Open the Door to Simpler System Creation Brochure, p/n 5989-2042EN

Ordering Information

6000L Series Low-profile Oscilloscopes

	DS06014L	DS06034L	DS06104L
Bandwidth	100 MHz	500 MHz	1 GHz
Channels Scopes	4 scope	4 scope	4 scope
Sample Rate	2 GSa/s	4 GSa/s	4 GSa/s
Standard Memory	2 Mpts	2 Mpts	2 Mpts

The above models include: user's guide, service guide, programmers guide, power code, 10:1 divider passive probe per scope channel, Agilent IO Libraries Suite 14.2, 1 year warranty, GPIB extender, LAN crossover cable, rack mount hardware

Standard Probes Included

	Passive Probes	Logic Cable Kit – Comes with MSO Upgrade Kit
DS06014L	10074C 10:1 passive probe (qty 4)	54826-68701 MSO logic cable kit (qty 1)
DS06034L	10073C 10:1 passive probe (qty 4)	54826-68701 MSO logic cable kit (qty 1)
DS06104L	10073C 10:1 passive probe (qty 4)	54826-68701 MSO logic cable kit (qty 1)

Available Options

		DS06014L	DS06054L/ DS06104L
N2914A	MSO upgrade kit for DS06014L	•	
N2915A	MSO upgrade kit for DS06054L/DS06104L		•
-SEC	Secure environment mode (factory installed option)	•	•
N5423A LSS	I ² C/SPI decode option	•	•
N5424A AMS	CAN, LIN and FlexRay decode option	•	•
N5432/FRS	Flex Ray decode option	•	•

Probe Options

10070C 1:1, 1 M Ω Passive Probe*
1147A 50 MHz, 50 A AC/DC Current Probe
10076A 100:1, 4 kV, 250 MHz High Voltage Probe
1144A 800 MHz Active Probe – order 1142A Power Supply
1145A 2 Channel 750 MHz Active Probe – order 1142A Power Supply
1156A 1.5 GHz Active Probe with AutoProbe Interface (power supply not required)
1130A 1.5 GHz InfiniiMax Probe Amplifier – no probe heads included**

Memory Upgrade

8ML – 100 MHz
 8MH – 500 MHz + 1 GHz

* fine-pitch and IC probing kits available (10072, 10075A).

** for a complete probing solution, also order a connectivity kit or individual probe head(s) (E2675A, E2668A, E2669A).

- Choose 600 MHz or 1 GHz bandwidth
- 4 GSa/s sample rate
- Up to 128 Mpts memory
- Open Windows XP Pro based with touch screen drag and drop measurements
- Extensive application software suite
- MegaZoom Technology powered deep memory, display and viewing system
- Unrivalled InfiniiMax active probes and accessories



Agilent's Infiniium oscilloscopes combine ease of use and the right specifications with a broad feature set to help you get your job done faster. If you are tired of spending 80 percent of your lab time fighting your instrumentation and only 20 percent making meaningful measurements, Infiniium is the scope for you.

Industry-Leading MegaZoom Deep Memory

MegaZoom is Agilent's unique, patented technology that gives you the advantages of deep memory without the usual drawbacks. MegaZoom deep memory lets you capture a full cycle of your system's operation and responsively zoom in on specific areas of interest. MegaZoom deep memory captures long records with fast waveform updates, minimizing dead-time between acquisitions.

Signal Integrity

If you are concerned about accurate reproduction of your signals as they appear on your device under test, you need the best end-to-end measurement system starting at the probe tip. The 1156A 1.5 GHz single-ended active probe is uniquely designed for a flat frequency response over the entire probe bandwidth, eliminating the distortion and frequency-dependent loading effects that are present in probes that have an in-band resonance. The InfiniiMax 1130A 1.5 GHz differential/single-ended active probe system builds on this technology by providing a variety of flexible probe heads to gain access to the most difficult to access test points.

Open Windows XP Pro Interface

Infiniium's intuitive Windows-based graphical user interface (GUI), coupled with its analog-like control knobs, puts the scopes' powerful measurements, waveform math functions, advanced analysis capabilities, and triggering at your fingertips. Infiniium's open Windows XP Professional architecture is a robust environment for installing third-party or custom analysis software applications inside the oscilloscope for the most expansive one-box test solution. The open architecture enables all the standard PC connectivity you are familiar with, making it easy to share your work and communicate your results. Infiniium features an email-ontrigger function that will send an email with date and time stamp in addition to an attached screen image to any email account in the world once a trigger event occurs. Use a Java™-Enabled Web browser to share access with team members working remotely from their very own PC.

Available Add On Application-specific Solutions

The PC platform of the Infiniium enables it to be the perfect place to run your software application right on the instrument. Agilent has created a wide selection of applications, available as add on options (either before or after purchase) to help take advantage of that PC power and get you further down the road to your end product.

Agilent Infiniium 8000 Series Selection Guide

	8064A		8104A	
	DSO8064A	MSO8064A	DSO8104A	MSO8104A
Bandwidth	600 MHz		1 GHz	
Channels Scopes	4 analog	4 analog + 16 digital logic	4 analog	4 analog + 16 digital logic
Sample Rate	4 GSa/s		4 GSa/s	
Maximum Memory	128 Mpts		128 Mpts	
Standard Memory	8 Mpts		8 Mpts	
Special Features	Advanced measurement suite with touch screen drag-and-drop capability. Extensive built-in waveform analysis with histograms, mask testing, and measurement statistics for full signal characterization. Segmented memory acquisition mode for efficient capture of bursting signals. Extensive Application suite available			

Specifications

	DSO8064A	MSO8064A	DSO8104A	MSO8104A
Bandwidth	600 MHz	600 MHz	1 GHz	1 GHz
Channels Scopes	4 analog	4 analog + 16 digital logic	4 analog	4 analog + 16 digital logic
Scope Channels				
Maximum Sample Rate	4 GSa/s	4 GSa/s	4 GSa/s	4 GSa/s
Maximum Memory	128 Mpts	128 Mpts	128 Mpts	128 Mpts
Standard Memory	8 Mpts	8 Mpts	8 Mpts	8 Mpts
Sampling Modes	Real time, equivalent time, peak detect, high resolution, averaging and segmented			
Max input, High Z	150 V RMS or dc, CAT I; ± 250 V (dc + ac) in AC coupling			
Max input, 50 Ohms	5 V RMS, CAT I			
Vertical Resolution	8 bits, >12 bits with averaging or high resolution modes			
Dynamic Range	± 8 div from center screen (1 M Ω) and ± 12 div from center screen (50 Ω)			
Logic Channels (MSO models only)				
Maximum Sample Rate	1 GSa/s	1 GSa/s	1 GSa/s	1 GSa/s
Maximum Memory	32 Mpts	32 Mpts	32 Mpts	32 Mpts
Input Level	500 mV p-p minimum, ± 40 V Maximum			
Threshold	± 8 V in 10 mV increments	± 8 V in 10 mV increments	± 8 V in 10 mV increments	± 8 V in 10 mV increments
Glitch Detection	2.5 ns minimum	2.5 ns minimum	2.5 ns minimum	2.5 ns minimum
Timebase				
Range	500 ps/div to 20 s/div	500 ps/div to 20 s/div	200 ps/div to 20 s/div	200 ps/div to 20 s/div
Resolution	4 ps	4 ps	4 ps	4 ps
Accuracy	15 ppm ($\pm 0.0015\%$)	15 ppm ($\pm 0.0015\%$)	15 ppm ($\pm 0.0015\%$)	15 ppm ($\pm 0.0015\%$)
Jitter Measurement Floor				
– time internal error	7 ps rms	7 ps rms	5 ps rms	5 ps rms
– period jitter	10 ps rms	10 ps rms	7 ps rms	7 ps rms
– N-cycle, Cycle-Cycle Jitter	15 ps rms	15 ps rms	11 ps rms	11 ps rms
Triggering	All Channels (Scope Channels 1 – 4 and Logic Channels D0 – D15) & External			
Source	Edge, glitch, line, pattern, state, delay by time, delay by events, TV & violation triggers			
Modes	(pulse width, setup/hold, and transition)			
Jitter	8 ps \pm 0.05 ppm x delay setting rms			
Display	8.4 inch diagonal color TFT-LCD; Maximum waveforms/second >8,800			
Waveform Measurements	Peak-to-Peak, Minimum, Maximum, Average, RMS, Amplitude, Base, Top, Overshoot, Preshoot,			
Voltage	Upper, Middle, Lower, Area			
Time	Period, Frequency, Positive Width, Negative Width, Duty Cycle, Delta Time, Rise Time, Fall Time,			
	Tmin, Tmax, Channel-to-Channel Phase			
Frequency Domain	FFT Frequency, FFT Magnitude, FFT Delta Frequency, FFT Delta Magnitude, FFT Phase			
Eye Pattern	Eye Height, Eye Width, Jitter, Crossing %, Q-Factor, Duty Cycle Distortion, Statistics, Histograms, Mask Testing			
Jitter clock (scope only)	Cycle-cycle jitter, N-cycle jitter, cycle-cycle +width, cycle-cycle –width, cycle-cycle duty cycle (all with EZJIT)			
Jitter data (scope only)	Time interval error (TIE), data rate, unit interval (all with EZJIT)			
Math Functions	Four functions f1 – f4. Select from add, average, common mode, differentiate, divide, FFT magnitude, FFT phase, high pass filter, integrate, invert, low pass filter, magnify, min, max, multiply, smoothing, subtract, versus			
Drives	≥ 40 GB internal hard drive (optional removable hard drive) CD-ROM drive on rear panel			
IO ports	LAN, GPIB, RS-232, Parallel, PS/2, USB 2.0, video output, auxiliary output, TTL trigger output			
Warranty	1 year standard, option increase to 3 years			
Size	216 mm H x 437 mm W x 440 mm D (8.5 in x 17.19 in x 17.34 in)			
Net Weight	Net: 13.4 kg (29.5 lbs.); Shipping: 16.4 kg (36.1 lbs.)			

Accessories

Extensive Application Software

The Agilent 8000 Series Infiniium Oscilloscope offers a broad portfolio of add-on applications that enable you to customize your oscilloscope. Agilent engineers have worked with industry experts to create software for the oscilloscope that will offer application specific insight and ultimately save you time. These options are available as add on options either before or after purchase.

Application Area	Application Name	Product Number/Option Number	Publication Number	Description
Digital Debug	FPGA dynamic probing Xilinx	N5397A	5989-1848EN	<ul style="list-style-type: none"> • Quickly and easily access your FPGA troubleshooting pins • Save time with easy signal identification • Enable measurement of a wide range of signals on our design without reprogramming your FPGA
	FPGA dynamic probing Altera	N5433A	5989-5940EN	<ul style="list-style-type: none"> • Quickly and easily access your FPGA troubleshooting pins • Save time with easy signal identification • Enable measurement of a wide range of signals on our design without reprogramming your FPGA
Serial Data Analysis	Low-speed serial data analysis for I ² C or SPI serial communication buses	N5391A	5989-1250EN	<ul style="list-style-type: none"> • Save time with automatic decode • Easily sort through data with click and zoom • Find the data you are looking for quickly with search functions for a particular packet
	CAN serial data analysis software	N5402A	5989-3632EN	<ul style="list-style-type: none"> • View both protocol and physical layer information directly on the Infiniium • Save time with automatic decode • Easily sort through data with click and zoom
	High-speed serial data analysis software	N5384A	5989-0108EN	<ul style="list-style-type: none"> • Effectively validate signal integrity • Recover embedded clock signals then display and make TIE Jitter measurements relative to them • Build and recover eye diagrams
Jitter Analysis	EZJIT Jitter Analysis	E2681A	5989-0109EN	<ul style="list-style-type: none"> • Access the measurements you need the most for Jitter; cycle-cycle jitter, N-cycle jitter, period jitter, time interval error, setup and hold time, measurement histograms, measurement trending and jitter spectrum • Save time with set-up wizard
Compliance Testing	Ethernet performance validation and compliance software	N5392A N5395B (Ethernet test fixture) N5396A (Gigabit Ethernet Jitter test cable)	5989-1527EN	<ul style="list-style-type: none"> • Quickly and easily verify and debug 1000Base-T, 1000base-TX, 10base-T Ethernet designs • Automatically execute Ethernet physical-layer electrical tests
	USB 2.0 performance validation and compliance software	N5416A E2646A (SQiDD test fixture)	5989-4044EN	<ul style="list-style-type: none"> • Fast and reliable way to verify SUB electrical specification compliance for USB 2.0 devices • Execute MATLAB USB-IF scripts inside the Infiniium
Vector Signal Analysis	VSA software for Infiniium	89601A	5989-0947EN	<ul style="list-style-type: none"> • Enables flexible signal analysis and demodulation up to 1 GHz bandwidth for troubleshooting wideband modulated signals in radar and communications applications

Accessories

Application Area	Application Name	Product Number/Option Number	Publication Number	Description
Usability Enhancements	My Infiniium	E2699A	5988-9934EN	• Launch your application directly from the oscilloscope front panel
	Communication Mast Test Kit	E2652A	5989-0372EN	• Ensure your design meets industry communication standards. Comes with a set of electrical communication adapters to ensure convenient, reliable, and accurate connections to your device under test
	VoiceControl software	E2682A		• Speak into the collar-mounted microphone to operate your Infiniium's front-panel controls without using your hands
	Logic Analyzer/Oscilloscope time correlation	E5805A		• Easily make time correlated measurements between an Agilent 16900 Series logic analysis system or Agilent 1680/90 Series benchtop logic analyzer and an Infiniium oscilloscope without a correlation fixture
	User Defined Function	N5430A	5989-5632EN	• Develop your own custom math functions or filters using MATLAB® and its Signal Processing Toolbox and display them on your oscilloscope along side the other standard functions*
	Infiniiscan	N5415A	5989-4605EN	• Quickly and easily identify signal integrity issues with InfiniScan. Isolate anomalous signal behavior with application scans through thousand of acquired waveforms. Capture anomalies that hardware-based solutions can't find

* User must purchase MATLAB® from The MathWorks separately.

Active Probes

Probing high-frequency signals becomes more challenging as the variety of test points and the frequencies of the signals continue to grow. Probes need to be lightweight, small, affordable, and offer the accessories and probe tips you require to get your job done easily. For high-speed differential signal measurements, the 1130A InfiniiMax differential probe amp, with its variety of probe heads, is a perfect compliment to the Infiniium 8000 Series oscilloscopes. Its 1.5 GHz bandwidth, extremely low input capacitance, high common mode rejection and the patented resistor probe tip technology provide ultra-low loading of the DUT and superior signal fidelity. The 1156A active probe is a small, low-mass, active probe also with 1.5 GHz bandwidth. The probe offers a flat frequency response across the entire probe bandwidth, even with a variety of accessories attached, giving you accurate insight into your high-speed measurement. Agilent offers a variety of probe tips to help you probe any test point.

Model	Probe Bandwidth	System Bandwidth	Single-ended/Differential
1156A	1.5 GHz	1 GHz with MSO8104A and DS08104A 600 MHz with MSO8064A and DS08064A	single-ended
1130A	1.5 GHz	1 GHz with MSO8104A and DS08104A	both ^{1,2}

¹ Depending on probe head used.

² For a complete probing solution, also order a connectivity kit or individual probe head(s).

Key Literature & Web Link

Infiniium 8000 Series Oscilloscopes Data Sheet, p/n 5989-4271EN
Infiniium Probes, Accessories and Options Data Sheet, p/n 5989-7141EN
Agilent Oscilloscope Probes and Accessories Selection Guide, p/n 5989-6162EN
Agilent 8000 Series Oscilloscopes Brochure, p/n 5989-5806EN

Ordering Information

Standard Probes Included

DS08064A 10073C 10:1 Passive Probe (qty 4)
MSO8064A 10073C 10:1 Passive Probe (qty 4), 54826-68701 MSO Logic Cable Kit (qty 1)
DS08104A 10073C 10:1 Passive Probe (qty 4)
MSO8104A 10073C 10:1 Passive Probe (qty 4), 54826-68701 MSO Logic Cable Kit (qty 1)

Memory Options

N5407A-080 16 Mpts on 2 Channels, 8 Mpts on 4 Channels
N5407A-160 32 Mpts on 2 Channels, 16 Mpts on 4 Channels
N5407A-320 64 Mpts on 2 Channels, 32 Mpts on 4 Channels
N5407A-640 128 Mpts on 2 Channels, 64 Mpts on 4 Channels

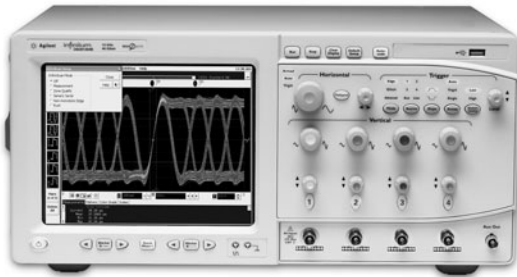
Probe and Accessory Options

1146A 100 kHz/100 A Current Probe, AC/DC
N2772A 20 MHz Differential Probe (Requires N2773A power supply)
10070C 1:1 Passive Probe with ID
10076A 100:1, 4 kV, 250 MHz Probe with ID
N2771A 1000:1, 15 kV, 50 MHz High-voltage Probe
N2780A 2 MHz/500 A Current Probe, AC/DC (Requires N2779A Power Supply)
N2781A 10 MHz/150 A Current Probe, AC/DC (Requires N2779A Power Supply)
N2782A 50 MHz/30 A Current Probe, AC/DC (Requires N2779A Power Supply)
N2783A 100 MHz/30 A Current Probe, AC/DC (Requires N2779A Power Supply)
1147A 50 MHz Current Probe, AC/DC with AutoProbe Interface
1141A 200 MHz Differential Probe (Requires 1142A probe control and power module)
1153A 200 MHz Differential Probe
1155A 750 MHz, 2-channel, Low-mass Active Probe
1156A 1.5 GHz Active Probe with AutoProbe Interface
1130A 1.5 GHz InfiniiMax Differential Probe Amplifier with AutoProbe Interface (Requires one or more InfiniiMax probe head – E2675A, E2668A, E2669A)
1144A 800 MHz Active Probe (Requires 1142A power supply)
N2916B Rackmount Kit for 5000/6000 Series Scope
N2917B Transit Case for 5000/6000 Series Scope
1180CZ Testmobile Scope Cart
N2919A Testmobile Bracket for 1180CZ and 6000 Series Scope
N2918A Oscilloscope Evaluation Kit for 6000 Series Scope
E5396A Half-size (17 channel) Soft Touch Connectorless Logic Probe for MSO Models

Miscellaneous Options

017 (factory installed) ≥40 GB Removable Hard Disk Drive.
Replaces ≥40 GB Internal Hard Disk with a ≥40 GB Removable Hard Disk.
Order the N5422A for Additional Hard Disk Drive Cartridges that contain the Full Windows Operating System and Oscilloscope Application.
1181BZ Testmobile System Cart
1184A Testmobile with Keyboard/Mouse Tray and Drawer for Accessories
E2609B Rackmount Kit
A6J ANSI Z540-compliant Calibration
R-51B-001-3C 1 Year Return-to-Agilent warranty extended to 3 Years

- Industry's lowest noise floor for both oscilloscopes and probes
- Industry's lowest jitter measurement floor
- Industry's lowest trigger jitter – less than 500 fs rms
- Industry's flattest frequency response
- Industry's only bandwidth upgradeable series from 2 GHz to 13 GHz
- Industry's largest selection of application software packages
- Industry's only full bandwidth economical lead-free solder-in probe solution
- Industry's first software event finder "InfiniiScan" (option)
- Now LXI functional class C compliant



Superior Signal Integrity and Probing for Your Application

The superior signal integrity, probing and application software selection of Agilent Technologies' Infiniium DSO/DSA80000B Series and InfiniiMax II probing system will lead to improved measurements and increased design margins.

The signal integrity advantages of Agilent's Infiniium 80000B Series Scopes and InfiniiMax Probing System include the industry's lowest noise floor, lowest jitter measurement floor, lowest trigger jitter and flattest frequency response. These foundational capabilities are crucial for achieving accurate and repeatable measurements. These superior signal integrity capabilities come from Agilent's RFdesign experience, proprietary packaging technologies and unique CMOS ADC architecture. Superior signal integrity maximizes engineer's design margins by not wasting any measurement accuracy due to the poor noise, jitter or frequency response of the scope or probing system.

Agilent Infiniium DSO/DSA80000B Series Oscilloscopes Selection Guide

	DSO/DSA81304B	DSO/DSA81204B	DSO/DSA81004B	DSO/DSA80804B	DSO/DSA80604B	DSO/DSA80404B	DSO/DSA80304B	DSO/DSA80204B
Bandwidth	13 GHz	12 GHz	10 GHz	8 GHz	6 GHz	4 GHz	3 GHz	2 GHz
Channels	4	4	4	4	4	4	4	4
Sampling Rate	20 – 40 GSa/s	20 – 40 GSa/s	20 – 40 GSa/s	20 – 40 GSa/s	20 – 40 GSa/s	20 – 40 GSa/s	20 – 40 GSa/s	20 – 40 GSa/s
Standard Memory	0.25 – 0.5 M	0.25 – 0.5 M	0.25 – 0.5 M	0.25 – 0.5 M	0.25 – 0.5 M	0.25 – 0.5 M	0.25 – 0.5 M	0.25 – 0.5 M
Max Memory (Option 001, standard on DSA Models)				1 – 2 M (64 M at 4 GSa/s)				
Rise Time/Fall Time (20 – 80%)	23 ps	25 ps	30 ps	38 ps	48 ps	91 ps	108 ps	152 ps
(10 – 90%)	33 ps	36 ps	42 ps	54 ps	70 ps	105 ps	108 ps	152 ps
Noise (rms at 100 mV/div)	3.3 mV	2.7 mV	2.3 mV	2.1 mV	1.8 mV	1.4 mV	1.2 mV	1.0 mV
Hardware Sensitivity (SW Expansion to 1 mV/div)	5 mV/div to 1 V/div	5 mV/div to 1 V/div	5 mV/div to 1 V/div	5 mV/div to 1 V/div	5 mV/div to 1 V/div	5 mV/div to 1 V/div	5 mV/div to 1 V/div	5 mV/div to 1 V/div
Timebase Range	5 ps/div to 20 s/div	5 ps/div to 20 s/div	5 ps/div to 20 s/div	5 ps/div to 20 s/div	5 ps/div to 20 s/div	5 ps/div to 20 s/div	5 ps/div to 20 s/div	5 ps/div to 20 s/div
Popular Scope Options	EZJIT Jitter Analysis Software (Option 002, Standard on DSA models) High Speed Serial Data Analysis Software (Option 003, Standard on DSA models) EZJIT Plus Advanced Jitter Analysis Software (Option 004, Standard on DSA models) Noise Reduction Software (Option 005, Standard on DSO/DSA81304B) My Infiniium Customization Software (Option 006) InfiniiScan Event Identification Software (Option 009) User Defined Function Software (Option 010)							

Oscilloscopes

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High-Performance Infiniium Oscilloscopes (cont.)

80000 Series



Infiniimax Probing System – Probe Amplifiers

	1169A	1168A	1134A	1132A	1131A	1130A
BW Spec	12 – 13 GHz	10 GHz	7 GHz	5 GHz	3.5 GHz	1.5 GHz
Recommended Oscilloscope	DSO81304B DSO81204B	DSO81004B DSO80804B	DSO80604B	DSO80404B	DSO80304B DSO80204B	DSO80204B
Attenuation	3.45:1	3.45:1	10:1	10:1	10:1	10:1
Dynamic Range	3.3 Vp-p	3.3 Vp-p	5 Vp-p	5 Vp-p	5 Vp-p	5 Vp-p
Noise Referred to Input	2.5 mV rms	2.5 mV rms	3.0 mV rms	3.0 mV rms	3.0 mV rms	3.0 mV rms

Infiniimax Probing Systems – Probe Heads

	N5380A	N5381A	N5382A	N5425A/ N5426A	E2675A	E2676A	E2677A	E2678A	E2679A	E2695A
Typ BW	13 GHz	13 GHz	13 GHz	13 GHz	6 GHz	6 GHz	12 GHz	12 GHz	6 GHz	8 GHz
Description	Hi-BW Differential SMA	Hi-BW Differential Solder-in	Hi-BW Differential Browser	Hi-BW Differential ZIF Solder-in	Differential Browser	Single-Ended Browser	Differential Solder-in	Differential Socket	Single-Ended Solder-in	Differential SMA
Diff Capacitance	—	0.21 pF	0.21 pF	0.33 pF	0.32 pF	0.67 pF	0.27 pF	0.34 pF	0.50 pF	—

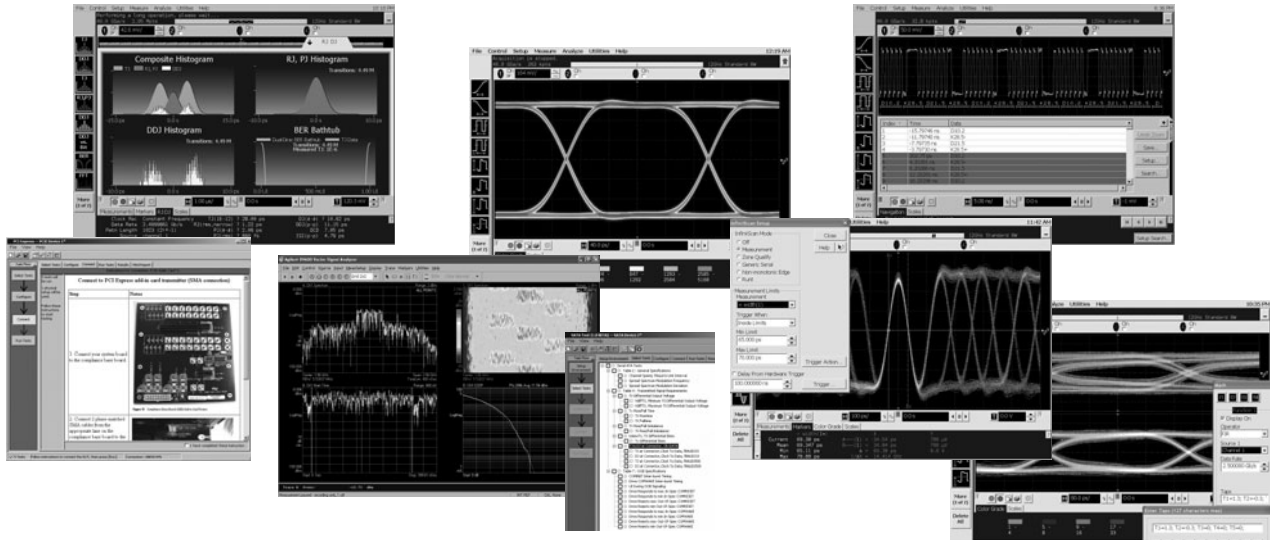
Infiniimax Probing Systems – Connectivity Kits and Misc

	E2669A	E2668A	E2697A
Description	Differential Kit	Single-Ended Kit	1 Mohm High Impedance Adapter
Includes	E2675A, E2677A x4, E2678A	E2676A, E2679A, E2678A	500 MHz Passive Probe

InfiniiMax Extreme Temperature Cable Extension

A SMP microwave extension cable from Gore (W. L. Gore & Associates, Inc.) is available for extending the reach of InfiniiMax probes into tight environments or into test chambers (Part number PRP042105-01). Please contact Gore at 1-800-311-3060 or look up international contacts at www.gore.com

Operating Temperature Range: 0 to 105°C



Infiniium Software Applications

Area	Part Number	Name	Description
Jitter	E2681A	EZJIT Jitter Analysis (Option 002)	Wizard based – measurements, histograms, measurement trending, jitter frequency spectrum
	N5400A	EZJIT Plus Jitter Analysis (Option 004)	Adds jitter separation into components and bit error rate projections. Same UI as 86100C Infiniium DCA-J
	E2690B	M1 Jitter Analysis (3rd Party)	Most advanced and flexible jitter analysis package. Supports offline analysis as well.
Serial Analysis	E2688A	High Speed SDA Serial Data Analysis (Option 003)	Wizard based – clock recovery, mask testing, real-time eyes with unfolding, 8b/10b decode, listing, and trigger
Compliance	N5393A	PCI Express 1.0/1.1 Compliance	Wizard based framework – test selection, configuration, connection, execution, results. Requires SDA
	N5392A	Ethernet Compliance (10/100BaseTX, Gigabit)	Wizard based framework – test selection, configuration, connection, execution, results
	N5394A	DVI Compliance	Wizard based framework – test selection, configuration, connection, execution, results
	N5399A	HDMI Compliance	Wizard based framework solution, supporting the latest HDMI 1.3. Listed in CTS 1.3.
	N5409A	Fully Buffered DIMM Compliance	Wizard based framework solution supporting FBD1/AMB1
	N5410A	Fiber Channel Compliance	Wizard based framework. Industry's only Fiber Channel compliance solution
	N5411A	Serial ATA Compliance	Wizard based framework, supporting both SATA gen 1 and gen 2
	N5412A	SAS Compliance	Wizard based framework for Serial Attached SCSI
	N5413A	DDR2 Full Compliance	Wizard based framework solution for both clock and data characterization
	N5416A	USB 2.0 Compliance	Wizard based framework based on USB-IF developed MATLAB script
	N5431A	XAUI Compliance	Wizard based framework for Industry's only XAUI compliance solution
	N5402A	CAN Serial Data Analysis	For CAN data analysis and decoding
	Serial ATA	Serial ATA Compliance	Free SATA I compliance solution from compliance body
	Fire-Wire	Fire-Wire Compliance (3rd Party)	FW compliance solution from 3rd party partner
	89601A	Vector Signal Analysis	Ultra-wide-band, multi-port vector signal analysis
Frequency Analysis	N5403A	Noise Reduction (Option 005)	DSP noise reduction feature at 10, 8, 6, 4, 2 and 1 GHz (DSO81204A/81004A/80804A Only)
Utilities	N5420A-G	After Burner II Bandwidth Upgrades	Upgrade any 80000 Series model to a higher bandwidth model
	N5391A	Low Speed Serial Data Analysis (Opt 21)	Decode I ² C and SPI low speed serial bus protocols
	N5414A	InfiniiScan Event Identification Software	Industry's first software triggering solution including the "Zone Trigger" feature
	N5430A	User Defined Function	Build your own analysis function through a seamless link to MATLAB
	E2625A	Communications Mask Test Kit	Low speed electrical mask testing for ANSI and ITU standards
	E2699A	My Infiniium Integration Package (Opt 6)	Customize Infiniium user interface to launch user-created or 3rd party executable programs
	E2682A	Voice Control Option	Hands free operation of the Infiniium Oscilloscope

- Modular platform for testing electrical and optical waveforms to 40 Gb/s and beyond
- Automated jitter and interference decomposition
- Internally generated pattern trigger
- Broadest coverage of data rates
- RIN measurements on PRBS signals
- Jitter spectrum of clock or data signals



Meeting Your Growing Need for More Bandwidth

Today's high data-rate signals have significant frequency content well beyond a real-time oscilloscope's 3 dB bandwidth. A high bandwidth scope does not alone guarantee an accurate representation of your waveform. Careful design of the DCA-J equivalent time sampling oscilloscope's frequency response (both amplitude and phase) minimizes distortion such as overshoot and ringing allowing the most precise signal analysis available from 50 Mb/s to over 40 Gb/s.

Four Instruments in One

The 86100C Infiniium DCA-J can be viewed as four high-powered instruments in one:

- A general-purpose wide-bandwidth sampling oscilloscope; the new PatternLock triggering significantly enhances the usability as a general purpose scope
- A digital communications analyzer; the new Eyeline Mode feature adds a powerful new tool to eye diagram analysis
- A time domain reflectometer
- A jitter and amplitude interference analyzer

In addition the 86100C Infiniium DCA-J can measure:

- Relative Intensity Noise (RIN) of lasers modulated with industry-standard PRBS signals
- Characterize the jitter spectrum of clock or data signals found in many computer architectures
- Lock its clock recovery onto Source Spectrum Clocking (SSC) signals

Configurable to Meet Your Needs

The 86100C supports a wide range of modules for testing both optical and electrical signals. Select modules to get the specific bandwidth and sensitivity you need.

Signal Integrity Analysis

The unique combination of wide bandwidth and low noise makes the DCA-J the most precise signal integrity analyzer available. Accurate eye-diagram analysis is essential for characterizing the quality of transmitters used from 50 Mb/s to 40 Gb/s and the DCA-J is designed specifically for the complex task of analyzing digital waveforms. Compliance mask and parametric testing can be performed with the touch of a single button.

Jitter and Amplitude Interference Analysis

Extremely wide bandwidth, low intrinsic jitter, and advanced analysis algorithms yield the highest accuracy in jitter measurements. As data rates increase in both electrical and optical applications, decomposition of jitter and amplitude interference into its constituent components is becoming more critical. It provides critical insight for jitter and amplitude budgeting and performance optimization in device and system designs. Many emerging standards require jitter decomposition for compliance. The DCA-J provides simple, one button setup and execution of advanced waveform analysis. Jitter Mode decomposes jitter and amplitude interference into its constituent components and presents jitter data in various insightful displays. Jitter Mode operates at all data rates the DCA-J supports. The 86100C brings several key attributes to jitter analysis:

- Very low intrinsic jitter (both random and deterministic) translates to the lowest jitter noise floor available providing unmatched jitter measurement sensitivity
- Wide bandwidth measurement channels with very low intrinsic jitter allow jitter and interference analysis on all data rates to 40 Gb/s and beyond
- Optimized frequency response (magnitude and phase) results in more accurate waveform representation

Internal Triggering Through Clock Recovery

Typically an external timing reference is used to trigger an equivalent time sampling oscilloscope to the test signal. In cases where a trigger signal is not available, clock recovery modules with adjustable PLL loop bandwidth are used to derive a timing reference directly from the waveform and provide golden PLL functionality for testing to industry standards.

PatternLock Triggering

The Enhanced Trigger Option (Option 001) enables the DCA-J to generate a trigger at the repetition of the input data pattern – a pattern trigger. PatternLock automatically detects the pattern length, data rate and clock rate enabling the 86100C to behave more like a real-time oscilloscope in terms of user experience. Users that are familiar with real-time oscilloscopes, but perhaps less so with equivalent time sampling scopes will be able to ramp up quickly.

Time Domain Reflectometry/Time Domain Transmission (TDR/TDT)

High-speed design starts with the physical structure. The transmission and reflection properties of electrical channels and components must be characterized to ensure sufficient signal integrity.

Use TDR and TDT to optimize microstrip lines, PC board traces, SMA edge launchers and coaxial cables.

Calibration techniques, unique to the DCA-J, provide the highest precision by removing cabling and fixturing effects from the measurement results. Translation of TDR data to complete single-ended, differential, and mixed mode S-parameters are available through the N1930A Physical Layer Test System software.

For specifications and ordering information refer to pages 76-79.

- Essential tools for the high speed digital designer
- Wide bandwidth oscilloscope
- Communications analyzer
- Signal integrity analyzer
- Interference and jitter analyzer
- RIN measurements on PRBS signals
- Jitter spectrum of clock and data signals



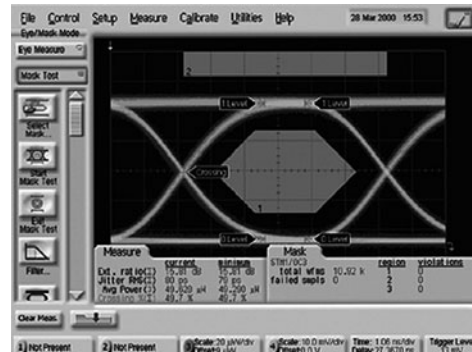
The ultimate flexible tool – the 86100C Infiniium DCA-J with advanced jitter analysis. Four instruments in one – a digital communications analyzer with automated eye measurements; a full-function time domain reflectometer (TDR) for impedance analysis; a full function oscilloscope with bandwidth in excess of 80 GHz; an innovative and accurate jitter analyzer for electrical and optical signals. With the ability to accept plug-in modules that you already own from the 83480A/54750A and 86100A/B, the DCA-J also protects your investment.

Capabilities

- Broadest coverage – receivers and clock recovery modules cover widest range of data rates and wavelengths
- Pattern lock – internally generates pattern trigger from an ordinary clock
- Eyeline mode – isolates specific bit sequences, creates an averaged eye diagram
- Interference and jitter mode – one-button RJ/DJ, RN/DI separation; accurate, stable, in-depth interference and jitter analysis at any rate-even beyond 40 Gb/s
- Jitter analysis with the 86107A precision timebase – achieve the most accurate jitter measurements with the lowest jitter intrinsic of any enterprise jitter solution to measure ultra high performance components
- TDR/TDT – accurately analyzes single-ended and differential devices; built-in calibration removes cabling/fixtures effects
- S-parameters – one button push shows you reflection and transmission parameters – Option 202 and TDR
- Open operating system – Windows® XP Pro allows external applications to be installed

Eye Diagram Mask Testing

The DCA-J provides efficient, high-throughput waveform compliance testing with a suite of standards based eye-diagram masks. The test process has been streamlined into a minimum number of keystrokes for testing at industry standard data rates.



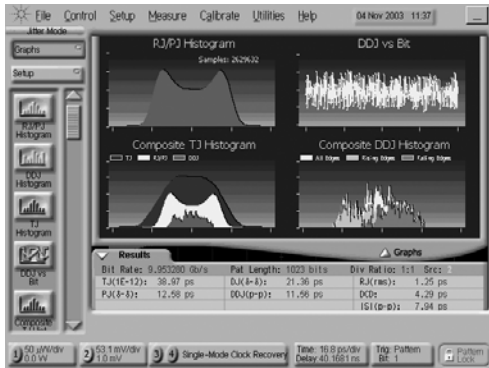
Standard Masks

	Rate (Mb/s)
• 1X Gigabit Ethernet	1250
• 2X Gigabit Ethernet	2500
• 10 Gigabit Ethernet	9953.28
• 10 Gigabit Ethernet	10312.5
• 10X Gigabit Ethernet FEC	11095.7
• Fibre Channel	1062.5
• 2X Fibre Channel	2125
• 4X Fibre Channel	4250
• 8X Fibre Channel	8500
• 10X Fibre Channel	10518.75
• 10X Fibre Channel FEC	11317
• STM0/OC1	51.84
• STM1/OC3	155.52
• STM4/OC12	622.08
• STM16/OC48	2488.3
• STM16/OC48 FEC	2666
• Infiniband	2500
• 10 Gigabit Ethernet LX4	3125
• STM64/OC192	9953.28
• STM64/OC192 FEC	10664.2
• STM64/OC192 FEC	10709
• STM64/OC192 Super FEC	12500
• STM256/OC768	39813
• STS1 EYE	51.84
• STS3 EYE	155.52

Other eye-diagram masks are easily created through scaling. In addition, mask editing allows for new masks either by editing existing masks, or creating new masks from scratch. A new mask can also be created or modified on an external PC using a text editor such as Notepad, then can be transferred to the instrument's hard drive using LAN, Flash drive, or USB devices.

Perform these mask conformance tests with convenient user-definable measurement conditions, such as mask margins for guardband testing, number of waveforms tested, and stop/limit actions.

86100C
DCA-J

86100C
DCA-J

Jitter Mode

Jitter Mode decomposes jitter and amplitude interference into its constituent components and presents jitter data in various insightful displays. Jitter Mode operates at all data rates the DCA-J supports, removing the traditional data rate limitations from complex jitter analysis. The DCA-J brings several key attributes to jitter analysis:

- Very low intrinsic jitter (both random and deterministic) translates to a very low jitter noise floor which provides unmatched jitter measurement sensitivity
- Wide bandwidth measurement channels deliver very low intrinsic data dependent jitter and allow analysis of jitter on all data rates to 40 Gb/s and beyond
- PatternLock triggering technology provides sampling efficiency that makes jitter measurements very fast

Analysis functionality is segmented into three software package options. Option 200 is the enhanced jitter analysis software, and Option 201 is the advanced waveform analysis software. Option 300 provides amplitude analysis and RIN. Option 200 includes:

- Decomposition of jitter into Total Jitter (TJ), Random Jitter (RJ), Deterministic Jitter (DJ), Periodic Jitter (PJ), Data Dependent Jitter (DDJ), Duty Cycle Distortion (DCD), and Jitter induced by Intersymbol Interference (ISI)
- Various graphical and tabular displays of jitter data
- Export of jitter data to convenient delimited text format
- Save/recall of jitter database
- Jitter frequency spectrum
- Isolation and analysis of Sub-Rate Jitter (SRJ), that is, periodic jitter that is at an integer sub-rate of the bitrate
- Bathtub curve display
- Adjustable total jitter probability

As bit rates increase, channel effects cause significant eye closure. Many new devices and systems are employing equalization and pre/de-emphasis to compensate for channel effects. Option 201 Advanced Waveform Analysis will provide key tools to enable design and test of devices and systems that must deal with difficult channel effects:

- Capture of long single valued waveforms. PatternLock triggering and the waveform append capability of Option 201 enable very accurate pulse train data sets up to 2×10^{23} bits long
- Equalization. The DCA-J can take a long single valued waveform and route it through an equalizer algorithm (default or user defined) and display the resultant equalized waveform in real time. The user can simultaneously view the input (distorted) and output (equalized) waveforms
- Interface to MatLab® analysis capability

Option 300 includes:

- Decomposition of amplitude interference into total interference (TI), deterministic interference (DI), random noise (RN), data dependent interference (DDI), inter-symbol interference (ISI), and periodic interference (PI)
- Various graphical and tabular displays of interference measurements
- Relative Intensity Noise (RIN 1 level or RIN OMA) using square-wave or industry-standard PRBS patterns
- Q-factor measurement

Option 300 requires options 200 (enhanced jitter software) and 001 (enhanced trigger hardware).

Internal Triggering Through Clock Recovery

Typically an external timing reference is used to synchronize the oscilloscope to the test signal. In cases where a trigger signal is not available, clock recovery modules are available to derive a timing reference directly from the waveform to be measured.

The 83496B provides the highest performance/flexibility as it is capable of operation at any data rate from 50 Mb/s to 13.5 Gb/s, on single-ended and differential electrical signals, single mode (1250 to 1620 nm) and multimode (780 to 1330 nm) optical signals, with extremely low residual jitter. PLL loop bandwidth is adjustable to provide optimal jitter filtering according to industry test standards.

Stimulus Response Testing Using the Agilent N490xA/B Bit Error Ratio Tester

Error performance analysis represents an essential part of digital transmission test. The DCA-J and Agilent N490xA/B Bit Error Ratio Tester error performance analyzer come together to create a powerful test solution where two instruments together can perform measurements that would otherwise be impossible.

Transitioning from the Agilent 83480A or 86100A/B to the Infiniium DCA-J

The 86100C Infiniium DCA-J has been designed to be a virtual drop-in replacement for the Agilent 83480A digital communications analyzer and Agilent 54750A wide-bandwidth oscilloscope. All modules used in the Agilent 83480A, 54750A, and 86100A/B can also be used in the 86100C Infiniium DCA-J. Some newer modules (such as the 86116C and the 83496B) work only in the 86100C Infiniium DCA-J.

Eyeline Mode

Eyeline Mode is a new feature only available in the DCA-J that provides insight into the effects of specific bit transitions within a data pattern. The unique view assists diagnosis of device or system failures due to specific transitions or sets of transitions within a pattern. When combined with mask limit tests, Eyeline Mode can quickly isolate the specific bit that caused a mask violation.

Traditional triggering methods on an equivalent time sampling scope are quite effective at generating eye diagrams. However, these eye diagrams are made up of samples whose timing relationship to the data pattern is effectively random, so a given eye will be made up of samples from many different bits in the pattern taken with no specific timing order. The result is that amplitude versus time trajectories of specific bits in the pattern are not visible. Also, averaging of the eye diagram is not valid, as the randomly related samples will effectively average to zero.

Eyeline Mode uses PatternLock triggering to build up an eye diagram from samples taken sequentially through the data pattern. This maintains a specific timing relationship between samples and allows Eyeline Mode to draw the eye based on specific bit trajectories. Effects of specific bit transitions can be investigated, and averaging can be used with the eye diagram.

Measurements

The following measurements are available from the tool bar, as well as the pull down menus. The available measurements depend on the DCA-J operating mode.

Jitter Mode

Jitter Mode requires Option 001 Enhanced Trigger hardware.

There are three analysis software packages for the DCA-J. Option 200 is the enhanced jitter analysis software, Option 201 is the advanced waveform analysis software, and option 300 is the advanced amplitude analysis software.

Measurements (Option 200 Jitter Analysis)

Total Jitter (TJ), Random Jitter (RJ), Deterministic Jitter (DJ), Periodic Jitter (PJ), Data Dependent Jitter (DDJ), Duty Cycle Distortion (DCD), Intersymbol Interference (ISI), Sib-Rate Jitter (SRJ)

Data Displays (Option 200 Jitter Analysis)

TJ histogram, RJ/PJ histogram, DDJ histogram, Composite histogram, DDJ versus Bit position, Composite DDJ, Bathtub curve, PJ Analysis, SRJ analysis, Aliased Spectrum, PJ Waveforms

Measurements (Option 201 Advanced Waveform Analysis)

Pattern waveform

Data Displays (Option 201 Advanced Waveform Analysis)

Equalized waveform

Measurements (Option 300 Advanced Amplitude Analysis)

Total Interference (TI), Deterministic Interference (DI), Random Noise (RN), Data Dependent Interference (DDI), Inter-Symbol Interference (ISI), Periodic Interference (PI)

Data Displays (Option 300 Advanced Amplitude Analysis)

TI histogram, RI/PI histogram, DDI histogram, Composite histogram, DDI versus Bit position

Oscilloscope Mode**Time**

Rise Time, Fall Time, Jitter RMS, Jitter p-p, Period, Frequency, + Pulse Width, – Pulse Width, Duty Cycle, Delta Time, [Tmax, Tmin, Tedge – remote commands only]

Amplitude

Overshoot, Average Power, V amptd, V p-p, V rms, V top, V base, V max, V min, V avg, Optional Modulation Amplitude (OMA)

Eye/Mask Mode**NRZ Eye Measurements**

Extinction Ratio, Jitter RMS, Jitter p-p, Average Power, Crossing Percentage, Rise Time, Fall Time, One Level, Zero Level, Eye Height, Eye Width, Signal to Noise (Q-Factor), Duty Cycle Distortion, Bit Rate, Eye Amplitude

RZ Eye Measurements

Extinction Ratio, Jitter RMS, Jitter p-p, Average Power, Rise Time, Fall Time, One Level, Zero Level, Eye Height, Eye Amplitude, Opening Factor, Eye Width, Pulse Width, Signal to Noise (Q-Factor), Duty Cycle, Bit Rate, Contrast Ratio

Mask Test

Open Mask, Start Mask Test, Exit Mask Test, Filter, Mask Test Margins, Mask Test Scaling, Create NRZ Mask

TDR/TDT Mode (requires TDR module)

Quick TDR, TDR/TDT Setup, Normalize, Response, Rise Time, Fall Time, Δ Time

Modules for the Agilent 86100C Infiniium DCA-J

The Infiniium DCA has a large family of plug-in modules designed for a broad range of data rates for optical and electrical waveforms. The DCA-J can hold up to 2 modules for a total of 4 measurement channels.

86100C Family Plug-in Module Matrix

Module	Option	Number of Optical Channels	Number of Electrical Channels	Wavelength Range (nm)	Unfiltered Optical Bandwidth (GHz)	Electrical Bandwidth (GHz)	Fiber Input (μm)	Mask Test Sensitivity (dBm)	Probe Power ¹	Filtered Data Rates																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
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										155	622	1063	1244/1250	2125	2488/2500	2.666	3.125	4.25	5.00	6.25	8.500	9.953	10.3125	10.51875	10.664	10.709	11.096	11.317	39.813	43.018																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
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¹ Module has receptacle to supply power for external probe. For modules without a probe power receptacle, use the 1143A Probe Power Supply.

² Pick any 4 rates (155 Mb/s to 8.5 Gb/s).

³ This module is not compatible with the 86100A and 86100B Digital Communication Analyzer (DCA) mainframes. If you would like to upgrade older DCAs contact Agilent Technologies and ask for current trade-in deals.

Module Specifications: 86106B, 86116A/B/C

High Bandwidth, Single-mode Optical/ Electrical Modules	86106B	86116A ¹	86116B ¹	86116C ¹
Optical Channel Specifications				
Optical Channel Unfiltered Bandwidth	28 GHz	53 GHz	65 GHz (best pulse fidelity)	65 GHz
Wavelength Range	1000 to 1600 nm		1480 to 1620 nm	1480 to 1620 nm
Calibrated Wavelengths	1310/1550 nm		1550 nm	1550 nm
Optical Sensitivity³	-7 dBm			-3 dBm
Transition Time (10% to 90%, calculated from TR = 0.48/BW optical)	18 ps	9.0 ps (FWHM) ²	7.4 ps (FWHM) ²	7.4 ps (FWHM) ²
RMS Noise				
Characteristic	13 μ W (Filtered) 23 μ W (Unfiltered)	60 μ W (50 GHz) 190 μ W (53 GHz)	50 μ W (55 GHz) 140 μ W (65 GHz)	36 μ W (39.8, 43.0 Gb/s filters) 125 μ W (65 GHz)
Maximum	15 μ W (Filtered) 30 μ W (Unfiltered)	90 μ W (50 GHz) 260 μ W (53 GHz)	85 μ W (55 GHz) 250 μ W (65 GHz)	68 μ W (39.8, 43.0 Gb/s filters) 200 μ W (65 GHz)
Scale Factor				
Minimum	20 μ W/division	200 μ W/division	200 μ W/division	200 μ W/division
Maximum	500 μ W/division	2.5 mW/division	5 mW/division	5 mW/division
CW Accuracy (single marker, referenced to average power monitor)	$\pm 50 \mu\text{W} \pm 4\%$ of (reading-channel offset)	$\pm 150 \mu\text{W} \pm 4\%$ of (reading-channel offset)	$\pm 150 \mu\text{W} \pm 4\%$ of (reading-channel offset)	$\pm 150 \mu\text{W} \pm 4\%$ of (reading-channel offset)
CW Offset Range (referenced two divisions from screen bottom)	+1 mW to -3 mW	+5 mW to -15 mW	+8 to -12 mW	+8 to -12 mW
Average Power Monitor (specified operating range)	-27 dBm to +3 dBm	-23 dBm to +9 dBm	-23 dBm to +9 dBm	-23 dBm to +9 dBm
Factory Calibrated Accuracy		$\pm 5\% \pm 100 \text{ nW} \pm$ connector uncertainty, 20°C to 30°C		
User Calibrated Accuracy		$\pm 2\% \pm 100 \text{ nW} \pm$ power meter uncertainty, <5°C change		
Maximum Input Power				
Maximum non-destruct average	2 mW (+3 dBm)	10 mW (+10 dBm)	10 mW (+10 dBm)	10 mW (+10 dBm)
Maximum non-destruct peak	10 mW (+10 dBm)	50 mW (+17 dBm)	50 mW (+17 dBm)	50 mW (+17 dBm)
Fiber Input	9/125 μ m, user selectable connector			
Input Return Loss (HMS-10 connector fully filled fiber)	30 dB	30 dB	20 dB	20 dB
Electrical Channel Specifications				
Electrical Channel Bandwidth	18 and 40 GHz	43 and 63 GHz	80, 55 and 30 GHz	80, 55 and 30 GHz
Transition Time (10% to 90%, calculated from TR = 0.35/BW)	19.5 ps (18 GHz) 9 ps (40 GHz)	8.1 ps (43 GHz) 5.6 ps (63 GHz)	6.4 ps (55 GHz) 4.4 ps (80 GHz)	6.4 ps (55 GHz) 4.4 ps (80 GHz)
RMS Noise				
Characteristic	0.25 mV (18 GHz) 0.5 mV (40 GHz)	0.6 mV (43 GHz) 1.7 mV (63 GHz)	0.6 mV (55 GHz) 1.1 mV (80 GHz)	0.5 mV (30 GHz) 1.1 mV (80 GHz)
Maximum	0.5 mV (18 GHz) 1.0 mV (40 GHz)	0.9 mV (43 GHz) 2.5 mV (63 GHz)	1.1 mV (55 GHz) 2.2 mV (80 GHz)	0.8 mV (30 GHz) 2.2 mV (80 GHz)
Scale Factor				
Minimum	1 mV/division	2 mV/division	2 mV/division	2 mV/division
Maximum	100 mV/division	100 mV/division	100 mV/division	100 mV/division
DC Accuracy (single marker)	$\pm 0.4\%$ of full scale $\pm 2 \text{ mV} \pm 1.5\%$ of (reading-channel offset), 18 GHz $\pm 0.4\%$ of full scale $\pm 2 \text{ mV} \pm 3\%$ of (reading-channel offset), 40 GHz	$\pm 0.8\%$ of full scale $\pm 2 \text{ mV} \pm 1.5\%$ of (reading-channel offset), 43 GHz $\pm 2.5\%$ of full scale $\pm 2 \text{ mV} \pm 2\%$ of (reading-channel offset), 63 GHz	$\pm 0.4\%$ of full scale $\pm 3 \text{ mV} \pm 2\%$ of (reading-channel offset), $\pm 2\%$ of offset (all bandwidths)	$\pm 0.4\%$ of full scale $\pm 3 \text{ mV} \pm 2\%$ of (reading-channel offset), $\pm 2\%$ of offset (all bandwidths)
DC Offset Range (referenced to center of screen)	$\pm 500 \text{ mV}$	$\pm 500 \text{ mV}$	$\pm 500 \text{ mV}$	$\pm 500 \text{ mV}$
Input Dynamic Range (relative to channel offset)	$\pm 400 \text{ mV}$	$\pm 400 \text{ mV}$	$\pm 400 \text{ mV}$	$\pm 400 \text{ mV}$
Maximum Input Signal	$\pm 2 \text{ V (+16 dBm)}$	$\pm 2 \text{ V (+16 dBm)}$	$\pm 2 \text{ V (+16 dBm)}$	$\pm 2 \text{ V (+16 dBm)}$
Nominal Impedance	50 Ω	50 Ω	50 Ω	50 Ω
Reflections (for 20 ps rise time)	5%	5%	10% (DC to 70 GHz) 20% (70 to 100 GHz)	10% (DC to 70 GHz) 20% (70 to 100 GHz)
Electrical Input	2.4 mm (male)	1.85 mm (male)	1.85 mm (male)	1.85 mm (male)

¹ 86116A and 86116B require the 86100 software revision A.3.0 or above. 86116C requires an 86100C mainframe and software revision 7.0.² FWHM (Full Width Half Max) as measured from optical pulse with 700 fs FWHM, 5 MHz repetition rate and 10 mW peak power.³ Smallest average optical power required for mask test. Values represent typical sensitivity of NRZ eye diagrams. Assumes mask test with compliance filter switched in.

Module Specifications: Single-mode & Multimode Optical/Electrical

86105B

86105C

Multimode and Single-mode Optical/Electrical Modules	86105B	86105C
Optical Channel Specifications		
Optical Channel Unfiltered Bandwidth	15 GHz	8.5 GHz (9 GHz)
Wavelength Range	1000 to 1600 nm	750 to 1650 nm
Calibrated Wavelengths	1310 nm/1550 nm	850 nm/1310 nm/1550 nm (± 20 nm)
Optical Sensitivity¹	-12 dBm	850 nm ≤ 2.666 Gb/s, -20 dBm > 2.666 Gb/s to ≤ 4.25 Gb/s, -19 dBm > 4.5 Gb/s to 11.3 Gb/s, -16 dBm 1310 nm/1550 nm ≤ 2.666 Gb/s, -21 dBm > 2.666 Gb/s to ≤ 4.25 Gb/s, -20 dBm > 4.25 Gb/s to 11.3 Gb/s, -17 dBm
Transition Time (10% to 90% calculated from TR=0.48/BW optical)	32 ps	56 ps
RMS Noise Characteristic	5 μ W, (10 GHz) 12 μ W, (15 GHz)	850 nm ≤ 2.666 Gb/s, 1.3 μ W > 2.666 Gb/s to ≤ 4.25 Gb/s, 1.5 μ W > 4.25 Gb/s to 11.3 Gb/s, 2.5 μ W 1310 nm/1550 nm ≤ 2.666 Gb/s, 0.8 μ W > 2.666 Gb/s to ≤ 4.25 Gb/s, 1.0 μ W > 4.25 Gb/s to 11.3 Gb/s, 1.4 μ W
Maximum	8 μ W, (10 GHz) 15 μ W, (15 GHz)	850 nm ≤ 2.666 Gb/s, 2.0 μ W > 2.666 Gb/s to ≤ 4.25 Gb/s, 2.5 μ W > 4.25 Gb/s to 11.3 Gb/s, 4.0 μ W 1310 nm/1550 nm ≤ 2.666 Gb/s, 1.3 μ W > 2.666 Gb/s to ≤ 4.25 Gb/s, 1.5 μ W > 4.25 Gb/s to 11.3 Gb/s, 2.5 μ W
Scale Factor (per division)		
Minimum	20 μ W	2 μ W
Maximum	500 μ W	100 μ W
CW Accuracy (single marker, referenced to average power monitor)	± 25 μ W $\pm 2\%$ (10 GHz) ± 25 μ W $\pm 4\%$ (15 GHz)	± 25 μ W $\pm 3\%$ ± 25 μ W $\pm 10\%$
CW Offset Range (referenced two divisions from screen bottom)	+1 μ W to -3 μ W	+0.2 μ W to -0.6 μ W
Average Power Monitor (specified operating range)	-30 dBm to +3 dBm	-30 dBm to 0 dBm
Average Power Monitor Accuracy Single-mode	$\pm 5\% \pm 100$ nW \pm connector uncertainty (20°C to 30°C)	$\pm 5\% \pm 200$ nW \pm connector uncertainty
Multimode (characteristic)	—	$\pm 10\% \pm 200$ nW \pm connector uncertainty
User Calibrated Accuracy Single-mode	$\pm 2\% \pm 100$ nW \pm power meter uncertainty, $< 5^\circ\text{C}$ change	$\pm 3\% \pm 200$ nW \pm power meter uncertainty, $< 5^\circ\text{C}$ change
Multimode (characteristic)	—	$\pm 10\% \pm 200$ nW \pm power meter uncertainty, $< 5^\circ\text{C}$ change
Maximum Input Power Maximum Non-destruct Average	2 μ W (+3 dBm)	0.5 μ W (-3 dBm)
Maximum Non-destruct Peak	10 μ W (+10 dBm)	5 μ W (+7 dBm)
Fiber Input	9/125 μ m user selectable connector	62.5/125 μ m
Input Return Loss (HMS-10 connector fully filled fiber)	33 dB	850 nm > 13 dB, 1310 nm/1550 nm > 24 dB

¹ Smallest average optical power required for mask test. Values represent typical sensitivity of NRZ eye diagrams. Assumes mask test with compliance filter switched in.

Module Specifications: Single-mode & Multimode Optical/Electrical

Multimode and Single-Mode Optical/Electrical Modules		86105B/C
Electrical Channel Specifications		
Electrical Channel Bandwidth		12.4 and 20 GHz
Transition Time (10% to 90%, calculated from $TR = 0.35/BW$)		28.2 ps (12.4 GHz) 17.5 ps (20 GHz)
RMS Noise		
Characteristic		0.25 mV (12.4 GHz) 0.5 mV (20 GHz)
Maximum		0.5 mV (12.4 GHz) 1 mV (20 GHz)
Scale Factor		
Minimum		1 mV/division
Maximum		100 mV/division
DC Accuracy (single marker)		$\pm 0.4\%$ of full scale ± 2 mV $\pm 1.5\%$ of (reading-channel offset), 12.4 GHz $\pm 0.4\%$ of full scale ± 2 mV $\pm 3\%$ of (reading-channel offset), 20 GHz
DC Offset Range (referenced to center of screen)		± 500 mV
Input Dynamic Range (relative to channel offset)		± 400 mV
Maximum Input Signal		± 2 V (+16 dBm)
Nominal Impedance		50 Ω
Reflections (for 30 ps rise time)		5%
Electrical Input		3.5 mm (male)

Module Specifications: Dual Electrical

54754A
86112A
86117A
86118A

Dual Electrical Channel Modules	86112A	54754A
Electrical Channel Bandwidth	12.4 and 20 GHz	12.4 and 18 GHz
Transition Time (10% to 90%, calculated from TR = 0.35/BW)	28.2 ps (12.4 GHz); 17.5 ps (20 GHz)	28.2 ps (12.4 GHz); 19.4 ps (18 GHz)
RMS Noise		
Characteristic	0.25 mV (12.4 GHz); 0.5 mV (20 GHz)	0.25 mV (12.4 GHz); 0.5 mV (18 GHz)
Maximum	0.5 mV (12.4 GHz); 1 mV (20 GHz)	0.5 mV (12.4 GHz); 1 mV (18 GHz)
Scale Factor		
Minimum	1 mV/division	1 mV/division
Maximum	100 mV/division	100 mV/division
DC Accuracy (single marker)	±0.4% of full scale ±2 mV ± 1.5% of (reading-channel offset), 12.4 GHz ±0.4% of full scale ±2 mV ± 3% of (reading-channel offset), 20 GHz	±0.4% of full scale ±2 mV ± 0.6% of (reading-channel offset), 12.4 GHz ±0.4% of full scale or marker reading (whichever is greater) ±2 mV ± 1.2% of (reading-channel offset), 18 GHz
CW Offset Range (referenced from center of screen)	±500 mV	±500 mV
Input Dynamic Range (relative to channel offset)	±400 mV	±400 mV
Maximum Input Signal	±2 V (+16 dBm)	±2 V (+16 dBm)
Nominal Impedance	50 Ω	50 Ω
Reflections (for 30 ps rise time)	5%	5%
Electrical Input	3.5 mm (male)	3.5 mm (male)

TDR Module	54754A
TDR Step Rise Time	
Oscilloscope/TDR Performance	40 ps nominal
Normalized Characteristics	Adjustable from larger of 10 ps or 0.08 x time/division. Maximum: 5 x time/division
TDR Step Flatness	
Oscilloscope/TDR Performance	≤±1% after 1 ns from edge; ≤±5% less than 1 ns from edge
Normalized Characteristics	≤0.1%
Low Level	0.00 V ± 2 mV
High Level	+200 mV ± 2 mV

Dual Electrical Channel Modules	86117A	86118A
Electrical Channel Bandwidth	30 and 50 GHz	50 and 70 GHz
Transition Time (10% to 90%, calculated from TR = 0.35/BW)	11.7 ps (30 GHz) 7 ps (50 GHz)	—
RMS Noise		
Characteristic	0.4 mV (30 GHz) 0.6 mV (50 GHz)	0.7 mV (50 GHz) 1.3 mV (70 GHz)
Maximum	0.7 mV (30 GHz) 1.0 mV (50 GHz)	1.8 mV (50 GHz) 2.5 mV (70 GHz)
Scale Factor		
Minimum	1 mV/division	1 mV/division
Maximum	100 mV/division	100 mV/division
DC Accuracy (single marker)	±0.4% of full scale ±2 mV ± 1.2% of (reading-channel offset) (30 GHz) ±0.4% of full scale ±2 mV ± 2% of (reading-channel offset) (50 GHz)	±0.4% of full scale ±2 mV ± 2% of (reading-channel offset) (50 GHz) ±0.4% of full scale ±2 mV ± 4% of (reading-channel offset) (70 GHz)
CW Offset Range (referenced from center of screen)	±500 mV	±500 mV
Input Dynamic Range (relative to channel offset)	±400 mV	±400 mV
Maximum Input Signal	±2 V (+16 dBm)	±2 V (+16 dBm)
Nominal Impedance	50 Ω	—
Reflections (for 30 ps rise time)	5%	20%
Electrical Input	2.4 mm (male)	1.85 mm (female)

Suggested Configurations for Common Applications

86100C Infiniium DCA-J Mainframe (option 1)				
Electrical 1 to 12 Gb/s	Electrical 20, 40 Gb/s	Optical 1 to 12 Gb/s	Optical 20, 40 Gb/s	TDR
86112A Dual channels >20 GHz each 83496B Electrical clock recovery (#100, 200, 300)	86118A Dual remote heads 70 GHz each 86107A Precision timebase (#040)	86105C 9 GHz optical channel 20 GHz electrical channel 83496B Optical clock recovery (#101, 200, 300)	86116C 65 GHz optical channel 80 GHz electrical channel 86107A Precision timebase (#040)	54754A Differential TDR/ Dual 18 GHz channels

Note: Other modules and options available. See the Technical Specifications, p/n 5989-0278EN or www.agilent.com for configuration details.

Ordering Information

86100C Infiniium DCA-J Mainframe

- 86100C-001** Enhanced Trigger
- 86100CS-001** Enhanced Trigger Upgrade Kit
- 86100C-701** Standard Trigger (default)
- 86100C-090** Removable Hard Drive
- 86100C-092** Internal Hard Drive (default)
- 86100C-200** Jitter Analysis Software
- 86100CU-200** Enhanced Jitter Analysis Software Upgrade
- 86100C-201** Advanced Waveform Analysis Software
- 86100CU-201** Advanced Waveform Analysis Software Upgrade
- 86100C-202** Enhanced Impedance and S-parameter Software
- 86100CU-202** Enhanced Impedance and S-parameter Software Upgrade
- 86100C-300** Amplitude Analysis/RIN/Q-factor
- 86100CU-300** Amplitude Analysis/RIN/Q-factor Upgrade
- 86100C-AFP** Module Slot Filler Panel
- 86100C-AX4** Rack Mount Flange Kit
- 86100C-AXE** Rack Mount Flange Kit with Handles
- 86100C-UK6** Commercial Cal Certificate with Test Data

N4688A External CD-RW Drive**Optical/Electrical Modules**

86105B 15 GHz Optical Channel; Single-mode, Unamplified
(1000 to 1600 nm), 20 GHz Electrical Channel

- 86105B-111** 9.953, 10.3125, 10.51875, 10.664, 10.709, 11.096, 11.317 Gb/s
- 86105B-112** 155, 622 Mb/s, 2.488, 2.5, 2.666, 9.953, 10.3125, 10.51875, 10.664, 10.709, 11.096, 11.317 Gb/s
- 86105B-113** 1.063, 1.250, 2.125, 2.488, 2.5, 9.953, 10.3125, 10.51875, 10.664, 10.709, 11.096, 11.317 Gb/s

86105C 9 GHz Optical Channel; Single-mode and Multimode, Amplified
(750 to 1650 nm), 20 GHz Electrical Channel

- 86105C-100** 155 Mb/s through 8.5 Gb/s (choose 4 data rates)
- 86105C-110** 155 Mb/s
- 86105C-120** 622 Mb/s
- 86105C-130** 1.063 Gb/s
- 86105C-140** 1.244/1.250 Gb/s
- 86105C-150** 2.125 Gb/s
- 86105C-160** 2.488, 2.500 Gb/s
- 86105C-170** 2.666 Gb/s
- 86105C-180** 3.125 Gb/s
- 86105C-190** 4.250 Gb/s
- 86105C-193** 5.0 Gb/s
- 86105C-195** 6.250 Gb/s
- 86105C-197** 8.500 Gb/s
- 86105C-200** 9.953, 10.3125, 10.519, 10.664, 10.709, 11.096, 11.317 Gb/s
- 86105C-300** Combination of Rates Available in 86105C-100 and 86105C-200

86106B 28 GHz Optical Channel; Single-mode, Unamplified
(1000 to 1600 nm) 9.953 Gb/s, 40 GHz Electrical Channel

- 86106B-410** 9.953, 10.3125, 10.664, 10.709 Gb/s

86116C 65 GHz optical channel; single-mode, unamplified
(1480 to 1620 nm), 80 GHz electrical channel. This module is not compatible with the 86100A and 86100B DCA mainframes. If you want to upgrade older DCAs, contact Agilent Technologies to discuss current trade-in deals.

All optical modules have FC/PC connectors installed on each optical port. Other connector adapters available as options are: Diamond HMS-10, DIN, ST and SC.

Dual Electrical Channel Modules

- 86112A** Dual 20 GHz Electrical Channels
- 86117A** Dual 50 GHz Electrical Channels
- 86118A** Dual 70 GHz Electrical Remote Sampling Channels
- 86118A-H01** Differential De-Skew

TDR/TDT Modules

Included with each of these TDR Modules is a TDR demo board, programmers guide, two 50 Ω SMA Terminations and one SMA short.
54754A Differential TDR Module with Dual 18 GHz TDR/Electrical Channels
N1020A 6 GHz TDR Probe Kit
N1024A TDR Calibration Kit

Trigger Module

- 86107A** Precision Timebase Reference Module
- 86107A-010** 2.5 and 10 GHz Clock Input Capability
- 86107A-020** 10 and 20 GHz Clock Input Capability
- 86107A-040** 10, 20 and 40 GHz Clock Input Capability

Clock Recovery Modules

The following modules provide a recovered clock from the data signal for triggering at indicated data rates:

- 83496A** 50 Mb/s to 7.1 Gb/s Clock Recovery Module
- 83496A-100** Single-ended and Differential Electrical with Integrated Signal Taps
- 83496A-101** Single-mode (1250 to 1620 nm) and Multimode (780 to 1330 nm) Optical. Integrated Signal Taps. Single-ended or Differential Electrical Inputs (no signal taps)
- 83496A-200** Increase Operating Range to 50 Mb/s to 13.5 Gb/s
- 83496AU-200** Upgrade Data Rate 0.05 Gb/s to 13.5 Gb/s
- 83496A-300** Add Tunable Loop Bandwidth "golden PLL" Capability
- 83496AU-300** Upgrade Adjustable Loop Bandwidth
- 83496B** 50 Mb/s to 7.1 Gb/s clock recovery module. This module is not compatible with the 86100A and 86100B DCA mainframes. If you want to upgrade older DCAs, contact Agilent Technologies and ask for current trade-in deals.
- 83496B-100** Single-ended and Differential Electrical with Integrated Signal Taps
- 83496B-101** Single-mode (1250 to 1620 nm) and Multimode (780 to 1330 nm) Optical. Integrated Signal Taps. Single-ended or Differential Electrical Inputs (no signal taps)
- 83496B-200** Increase Operating Range to 50 Mb/s to 13.5 Gb/s
- 83496BU-200** Upgrade Data Rate 0.05 Gb/s to 13.5 Gb/s
- 83496B-201** Shift Operating Range to 7.1 to 13.5 Gb/s
- 83496BU-201** Upgrade Shift Operating Range to 7.1 to 13.5 Gb/s
- 83496B-300** Add Tunable Loop Bandwidth "golden PLL" Capability
- 83496BU-300** Upgrade Adjustable Loop Bandwidth

Warranty Options (for all products)

- R1280A** Customer Return Repair Service
- R1282A** Customer Return Calibration Service

Accessories

- 86101-60005** Filler Panel
- 0960-2427** USB Keyboard (included with 86100C)
- 1150-7799** USB Mouse (included with 86100C)

Note: 86100C-200 and 86100C-201 require Option 001 (enhanced trigger). 86100C-300 requires Options 200 and 001.

Optical Connector Adapters

Optical modules come standard with one FC/PC connector adapter

81000 AI Diamond HMS-10 Connector

81000 FI FC/PC Connector Adapter

81000 SI DIN Connector Adapter

81000 VI ST Connector Adapter

81000 KI SC Connector Adapter

RF/Microwave Accessories

11667B Power Splitter, DC to 26.5 GHz, APC 3.5 mm

11667C Power Splitter, DC to 50 GHz, 2.4 mm

11742A 45 MHz to 26.5 GHz DC Blocking Capacitor

11742A-K01 50 GHz DC Blocking Capacitor

8490D-020 2.4 mm 20 dB Attenuator

11900B 2.4 mm (f-f) Adapter

11901B 2.4 mm (f) to 3.5 mm (f) Adapter

11901C 2.4 mm (m) to 3.5 mm (f) Adapter

11901D 2.4 mm (f) to 3.5 mm (m) Adapter

5061-5311 3.5 mm (f-f) Adapter

1250-1158 SMA (f-f) Adapter

1810-0118 3.5 mm Termination

Passive Probe

54006A 6 GHz Passive Probe

InfiniiMax I Active Probes (1.5 to 7 GHz)

The N1022A probe adapter is required to use these probes with the DCA-J

InfiniiMax I Probe Amplifiers

Order 1 or more InfiniiMax I probe head or connectivity kit for each amplifier

1130A 1.5 GHz Probe Amplifier

1131A 3.5 GHz Probe Amplifier

1132A 5 GHz Iprobe Amplifier

1134A 7 GHz Probe Amplifier

InfiniiMax I Probe Heads

E2675A InfiniiMax Differential Browser Probe Head and Accessories. Includes 20 Replaceable Tips and Ergonomic Handle. Order E2658A for Replacement Accessories

E2676A InfiniiMax Single-ended Browser Probe Head and Accessories. Includes 2 Ground Collar Assemblies, 10 Replaceable Tips, a Ground Lead Socket and Ergonomic Browser Handle. Order E2663A for Replacement Accessories

E2677A InfiniiMax Differential Solder-in Probe Head and Accessories. Includes 20 Full Bandwidth and 10 Medium Bandwidth Damping Resistors. Order E2670A for Replacement Accessories

E2678A InfiniiMax Single-ended/Differential Socketed Probe Head and Accessories. Includes 48 Full Bandwidth Damping Resistors, 6 Damped Wire Accessories, 4 Square Pin Sockets and Socket Heatshrink. Order E2671A for Replacement Accessories

E2679A InfiniiMax Single-ended Solder-in Probe Head and Accessories. Includes 16 Full Bandwidth and 8 Medium Bandwidth Damping Resistors and 24 Zero Ohm Ground Resistors. Order E2672A for Replacement Accessories

InfiniiMax I Connectivity Kits (popular collections of the above probe heads)

E2669A InfiniiMax Connectivity Kit for Differential Measurements

E2668A InfiniiMax Connectivity Kit for Single-ended Measurements

InfiniiMax II Active Probes (10 to 13 GHz)

The N1022A probe adapter is required to use these probes with the DCA-J

InfiniiMax II Probe Amplifiers

Order 1 or more InfiniiMax II probe heads for each amplifier. InfiniiMax II probe heads and connectivity kits can also be used but will have limited bandwidth

1168A 10 GHz Probe Amplifier

1169A 13 GHz Probe Amplifier

InfiniiMax II Probe Heads

N5380A InfiniiMax II 12 GHz Differential SMA Adapter

N5381A InfiniiMax II 12 GHz Solder-in Probe Head

N5382A InfiniiMax II 12 GHz Differential Browser

Probe Adapters

N1022A Adapts 113x/115x/116x Active Probes to DCA-J

Connectivity Solutions**HDMI**

N1080A H01 High Performance Coax Based HDMI Fixture with Plug (TPA-P)

N1080A H02 High Performance Coax Based HDMI Fixture with Receptacle (TPA-R)

N1080A H03 HDMI Low Frequency Board

SATA

iSATA Plug to SMA – COMAX P/N H303000104

iSATA Receptacle to SMA – COMAX P/N H303000204

These are available from COMAX Technology, see www.comaxtech.com

ATCA

Advanced TCA Tx/Rx Signal Blade™

Advanced TCA Tx/Rx Bench Blade™

These are available from F9 Systems, see www.f9-systems.com

Call Agilent for connectivity and probing solutions not listed above.

Firmware and Software

Firmware and Software Upgrades are available through the web or your local sales office. www.agilent.com/find/dcaj

Upgrade Services

86100CS-001 Enhanced Trigger Hardware Upgrade

86100CU-200 Enhanced Jitter Analysis SW Upgrade

86100CU-201 Advanced Waveform Analysis SW Upgrade

86100CU-202 Enhanced Impedance and S-parameter Software Upgrade

86100CU-300 Advanced Amplitude Analysis SW Upgrade

83496A – 83496B Performance Upgrade Contact your local Agilent Service Center and request Service Note 83496A-02

86100A/B to 86100C Upgrade Contact Agilent Technologies for current trade-in deals

86100C

DCA-J

Oscilloscope Probes & Accessories

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Choosing the Right Probe

Recommended Oscilloscope/Probe Compatibility Chart

Oscilloscope	General Purpose Passive Probes									
	10:1	100:1	1000:1	1:1	Low Mass 10:1	Low Z	50 Ohm	Active Single Ended	Active Differential	Current
DSO3000A	N2862A, N2863A	10076A	N2771A	10070C	—	—	—	—	1141A ³ , N2772A	1146A, N2780/1/2/3A ⁷
DSO5000A	N2863A, 10073C	10076A	N2771A	10070C	—	—	—	1156A, 1144A ³ , 1145A ³	1130A ⁴ , 1141A ³ , N2772A	1146A, 1147A, N2780/1/2/3A ⁷
Infiniium 54810/15/20/25A	1160A, 1164A	10440B ² , 10076A	N2771A	1162A	—	1163A	10437B	1152A, 1155A, 1156A	1153A ²	1146A, 1147A, N2780/1/2/3A
Infiniium 54830/31/32/33B/D, 8000 Series	10073C, 1165A	10440B ² , 10076A	N2771A	1162A	1171A	1163A	10437B	1156A, 1155A,	1153A ² , 1154A, 1159A, 1130A ⁴	1146A, 1147A, N2780/1/2/3A ⁷
Infiniium 54835A, 54845A/B, 54846A/B	1161A	10440B ² , 10076A	N2771A	1162A	—	1163A	10437B	1152A ³ , 1155A ² , 1156A	1153A ² , 1154A, 1159A, 1130/32A ⁴	1146A, 1147A, N2780/1/2/3A
54751/52A/B	—	—	—	—	—	54006A	—	54701A ^{2,4}	1141A ³	—
54711/12/21/22A	—	—	—	—	—	54006A	—	54701A ⁴	1141A ³	—
54714/15A/13B	10441B, 10073C	10440B, 10076A	N2771A	10439B, 10070C	1170A ¹	10442B, 1163A ¹	10437B	1144A ³ , 1145A ³ , 54701A ⁴	1141A ³	—
MSO/DSO6000 (300 MHz – 1 GHz)	10073C	10076A	N2771A	10070C	—	—	—	1156A, 1144A ³ , 1145A ³	1130 ⁴ , 1141A ³ , N2772A	1146A, 1147A, N2780/1/2/3A ⁷
MSO/DSO6000 (100 MHz)	10074C	10076A	N2771A	10070C	—	—	—	—	1141A ^{2,3} , N2772A	1146A, N2780/1/2/3A ⁷
54645A/D	10074C	10440B, 10076A	N2771A	10070C	1171A ¹	—	—	1144A ^{2,3} , 1145A ^{2,3}	1141A ^{2,3} , N2772A	1146A, N2780/1/2/3A ⁷
54621A/D, 54622A/D/24A	10074C	10440B, 10076A	N2771A	10070C, 10439B	1171A ¹	—	—	—	1141A ^{2,3}	1146A, N2774A ⁵
54641A/D, 54642A/D	10073C	10440B, 10076A	N2771A	10070C	1171A ¹	—	—	1144A ³ , 1145A ³	1141A ³	1146A, N2780/1/2/3A ⁷
54615/16B/16C	10073C	10440B, 10076A	N2771A	10070C, 10439B	—	1163A ¹ , 10442B	10437B	1144A ³ , 1145A ³	1141A ³ , N2772A	1146A, N2780/1/2/3A ⁷
54610A/B	10073C	10440B, 10076A	N2771A	10070C, 10439B	—	1163A ¹ , 10442B	10437B	1144A ³ , 1145A ³	1141A ³ , N2772A	1146A, N2780/1/2/3A ⁷
54600/01/02/03A/B	10074C	10440B, 10076A	N2771A	10070C, 10439B	1171A ¹	—	—	1144A ^{2,3} , 1145A ^{2,3}	1141A ^{2,3} , N2772A	1146A, N2780/1/2/3A ⁷

¹ Must remove pogo pin and configure scope for probe manually.

² User with 50 ohm termination adapter.

³ Requires the 1142A probe power supply.

⁴ Requires the 1143A probe offset and power module.

⁵ Requires N2775A power supply.

⁶ Requires one or more InfiniiMax probe heads or connectivity kit per amplifier.

⁷ Requires N2779A power supply.

3



10070 Passive Divider Probe Series.

10070 Passive Divider Probe Family

The 10070 family of rugged, general purpose probes are designed to operate with the 6000 and 54600 family of oscilloscopes. This family provides a range of high-quality probing solutions at very reasonable prices.

These reliable probes come with one retractable hook tip, eight color identification tags, one ground bayonet, one IC Tip, one adjustment tool, and one ground lead.

See page 87 for compatible SMT probing kit.

10070
Family
N2862A
N2863A

Model	Length	Division Ratio	Circuit Loading (1 M Ω scope input)	Typical Scope Bandwidth	Compensates Oscilloscope Input
10070C	1.5 m	1:1	1 M Ω ; 70 pF	20 MHz	High Impedance
10073C	1.5 m	10:1	2.2 M Ω ; 12 pF	500 MHz	1 M Ω ; 6 to 15 pF
10074C ¹	1.5 m	10:1	10 M Ω ; 15 pF	150 MHz	1 M Ω ; 9 to 17 pF
10076A	1.8 m	100:1	66.7 M Ω ; 3 pF	250 MHz	1 M Ω ; 7 to 20 pF

¹ Probe ID pin.

Other 10070 Series Probe Accessories

Accessory	p/n
Probe tip to BNC (m) adapter	5081-7705
Replacement parts accessory kit	5081-7690
SMT probe accessory kit	10072A
0.5 mm IC probing kit	10075A
Retractable hook tip, qty 2	N2769A
Alligator ground lead, qty 2	N2770A

Other Accessories

Accessory	p/n
BNC 50 Ω feedthrough	10100C
BNC 75 Ω feedthrough	11094B
BNC AC blocking capacitor	10240B

N2862/63A Low-cost Passive Probe Family

The Agilent N2862A and N2863A low-cost passive probes provide a 10:1 attenuation and features a high input resistance of 10 Mohm. The probes can be adjusted for low-frequency compensation and high-frequency compensation. The probes are compatible with wide range of oscilloscopes and provide a high quality probing solution at affordable prices.



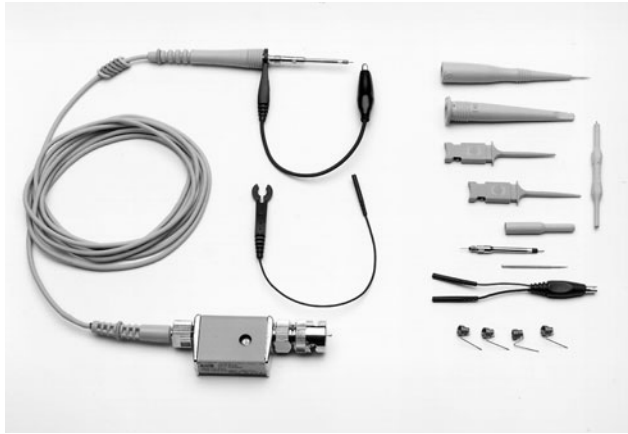
Model	Length	Division Ratio	Circuit Loading (1 M Ω scope input)	Bandwidth	Scope Compensation
N2862A	1.2 m	10:1	10 M Ω ; 12 pF	150 MHz	5 – 30 pF
N2863A	1.2 m	10:1	10 M Ω ; 12 pF	300 MHz	5 – 30 pF

Oscilloscope Probes & Accessories

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High-Impedance Passive Probes

10400
Family



10400B Passive Divider Probe Series.

10400B Passive Divider Probe Family

The 10400B probe family are reliable general-purpose high performance passive probes that replace the 10400A family of probes. These probes include a no-slip browser. The crown point of the browser digs in to solder and won't slip while the pogo pin allows small hand movements without losing contact.

The 10400B family of probes also comes complete with a range of accessories. For grounding, there's an alligator ground lead for general-purpose probing, 4 spring grounds for high frequency measurements and a socketed ground lead. The accessories also include 2 IC clips for probing 50 mil SMDs and a dual-lead adapter so that both the probe tip and ground can easily be connected to surface mount devices.

The miniature probe has a narrow, sharp tip that is good for probing SMDs. The handle of the probe can be unscrewed and pulled back on the cable to reduce the probe's mass and size. This makes attaching to fine pitch ICs and small devices easier. For connection to fine pitch ICs order the Wedge probe adapter or the 0.5 mm IC clips.

The 10400 family of probes are built and tested for high reliability. The cable has a Kevlar strengthener for added pull strength and the general purpose retractable hook tip is made from durable music wire. The probe tips are replaceable.

See page 87 for compatible SMT probing solutions.

Model	Length	Division Ratio	Circuit Loading	Typical Scope Bandwidth	Compensates Oscilloscope Input
10437B	2 m	1:1	50 Ohm	—	50 Ohm
10439B ¹	1.5 m	1:1	65 pF	—	High Z
10433B	2 m	10:1	10 MOhm; 10 pF	300 MHz	1 MOhm; 10 – 16 pF
10436B	2 m	10:1	10 MOhm; 11 pF	100 MHz	1 MOhm; 18 – 22 pF
10441B	1.8 m	10:1	10 MOhm; 9 pF	500 MHz	1 MOhm; 6 – 9 pF
10442B	2 m	10:1	500 Ohm; 1.2 pF	1 GHz	50 Ohm
10440B	2 m	100:1	10 MOhm; 2.5 pF	300 MHz	1 MOhm; 6 – 14 pF

¹ This probe can be used with many oscilloscopes, but because of the relatively high capacitance, there will be bandwidth degradation.

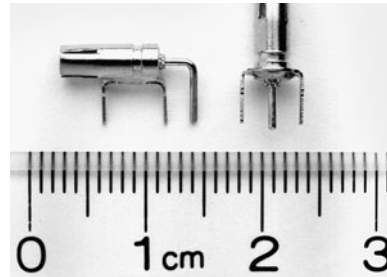
10400B Family Replacement Parts

p/n	Description	Qty
5063-2115	Browser	1
5063-2120	Socketed ground lead	1
5063-2135	General-purpose retractable hook tip	2
5063-2140	Alligator ground lead	2
5063-2147	Dual lead adapter	1
5063-2149	SMD clips	5
01160-68701	Accessory Kit: Spring grounds Browser pogo pins Barrel insulators Screwdriver	4 4 4 1
5063-2167	10433B probe tip	5
5063-2168	10436B probe tip	5
5063-2138	10437B probe tip	5
5063-2138	10439B probe tip	5
5063-2171	10440B probe tip	5
5063-2172	10441B probe tip	5
5063-2139	10442B probe tip	5

Fine Pitch IC Probing Accessories

p/n	Description	Qty
E2613B	Wedge probe adapter, 0.5 mm, 3-signal	2
E2614A	Wedge probe adapter, 0.5 mm, 8-signal	1
E2615B	Wedge probe adapter, 0.65 mm, 3-signal	2
E2616A	Wedge probe adapter, 0.65 mm, 8-signal	1
E2643A	Wedge probe adapter, 0.5 mm, 16-signal	1
E2644A	Wedge probe adapter, 0.65 mm, 16-signal	1
10467-68701	0.5 mm IC clips for surface SMT parts with lead spacings of 0.5 mm (0.020 in) to 0.8 mm (0.32 in)	4

PC Board Mini-Probe Sockets



The PC board mini-probe sockets are ideal for reliable, stable, and convenient connection between the probe tip and the circuit under test. These probe sockets are designed for use with the 1160A-family and 10400B-family of passive probes.

Ordering Information

N2766A Horizontal Mini-Probe Socket, qty 25

N2768A Vertical Mini-Probe Socket, qty 25



1160A Miniature Passive Probe Series.

1160A Family Miniature Passive Probes

The 1160 family of miniature probes are reliable general-purpose probes for use with Infiniium Oscilloscopes. The 1160 family probes include a no-slip browser with a crown point that digs in to solder, and won't slip. The pogo pin allows hand movement without losing contact.

A variety of grounding accessories are included. An alligator ground lead for general-purpose probing, 4 spring grounds for high frequency measurements, a socketed ground lead and 2 SMD IC clips for probing 50 mil SMD. Also included is a dual lead adapter so that both the probe tip and ground can be connected to SMD devices. For connection to 0.5 mm – 0.8 mm devices, order the 10467-68701 0.5 mm IC clips.

The 1160 family probes are built and tested for high reliability. The cable has a kevlar strengthener for added pull strength. The general-purpose retractable hook tip has a durable music wire hook. And probe tips are replaceable.

The miniature probe has a narrow, sharp tip that is good for probing SMD. To fully miniaturize the probe, unscrew the handle and pull it back on the cable. The 1160 family probes are compatible with the AutoProbe Interface, which completely configures the Infiniium Oscilloscope for the probe.

Model	Type of Probe	Length	Division Ratio	Circuit Loading	System Bandwidth (Scope and Probe)	Oscilloscope Input
1160A	High Impedance, Passive	1.5 m	10:1	10 MOhm, 9 pF	500 MHz ¹	1 MOhm, 6 – 9 pF
1161A	High Impedance, Passive	1.5 m	10:1	10 MOhm, 10 pF	500 MHz ²	1 MOhm, 12 – 14 pF
1162A	High Impedance, Passive	1.5 m	1:1	1 MOhm, 50 pF + scope input	25 MHz ³	1 MOhm
1163A	500 Ohm Resistive Divider	1.5 m	10:1	500 Ohm, 1.5 pF	1.5 GHz ²	50 Ohm
1164A	High Impedance, Passive	2.0 m	10:1	10 MOhm, 10 pF	500 MHz ¹	1 MOhm, 6 – 9 pF
1165A	High Impedance, Passive	1.5 m	10:1	10 MOhm, 10 pF	600 MHz ⁴	1 MOhm, 12 – 14 pF

¹ System bandwidth with 54810A/15A/20A/25A.

² System bandwidth with 54845A.

³ System bandwidth with all Infiniium scopes.

⁴ System bandwidth with 54830B/31B/32B/30D/31D/32D/33A/33D, DSO/MS08064A and DSO/MS08104A.

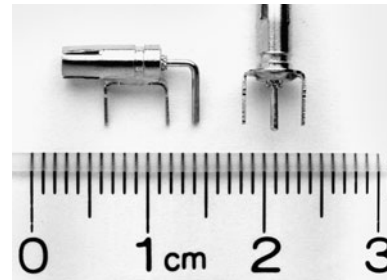
1160 Family Replacement Parts

p/n	Description	Qty
5063-2115	Browser	1
5063-2120	Socketed ground lead	1
5063-2135	General-purpose retractable hook tip	2
5063-2140	Alligator ground lead	2
5063-2147	Dual lead adapter	1
5063-2149	SMD IC clips	5
01160-68701	Accessory kit: Spring grounds Browser pogo pins Barrel insulators Screwdriver	4 4 4 1
5063-2136	1160A probe tip	5
5063-2137	1161A/65A probe tip	5
5063-2138	1162A probe tip	5
5063-2139	1163A probe tip	5
5063-2151	1164A probe tip	5

Fine Pitch IC Probing Accessories

p/n	Description	Qty
E2613B	Wedge probe adapter, 0.5 mm, 3-signal	2
E2614A	Wedge probe adapter, 0.5 mm, 8-signal	1
E2615B	Wedge probe adapter, 0.65 mm, 3-signal	2
E2616A	Wedge probe adapter, 0.65 mm, 8-signal	1
E2643A	Wedge probe adapter, 0.5 mm, 16-signal	1
E2644A	Wedge probe adapter, 0.65 mm, 16-signal	1
10467-68701	0.5 mm IC clips for surface SMT parts with lead spacings of 0.5 mm (0.020 in) to 0.8 mm (0.032 in)	4

PC Board Mini-Probe Sockets



The PC board mini-probe sockets are ideal for reliable, stable, and convenient connection between the probe tip and the circuit under test. These probe sockets are designed for use with the 1160A-family and 10400B-family of passive probes.

Ordering Information

N2766A Horizontal Mini-Probe Socket, qty 25

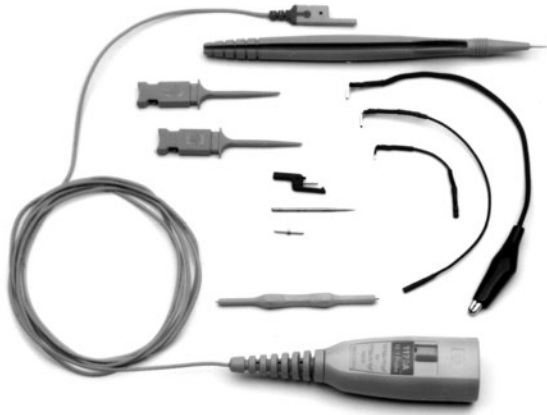
N2768A Vertical Mini-Probe Socket, qty 25

Oscilloscope Probes & Accessories

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117x Low Mass Passive Probe Family

1171A
10467-
68701
E2613A
E2613B
E2614A
E2615A
E2615B
E2616A

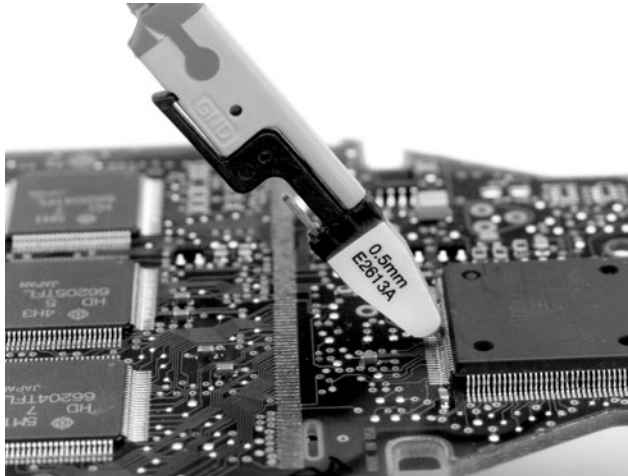


The 117x Low Mass Passive Probe.

The 117x family of low mass high performance passive probes for the Infiniium Oscilloscopes is designed specifically to make the probing of fine pitch ICs and dense circuit boards easier. The probe tip is exceptionally small and light, weighing less than 1 gram, so it is easier to attach to those small devices and surface mount ICs. Even though small and light, these probes are designed for high performance and the ruggedness required for general purpose use. The cable is re-enforced with Kevlar for added pull strength.

The probe also includes a no-slip browser for precise and safe browsing. The crown point of the browser digs in to solder and won't slip and the pogo pin allows small movements without losing contact.

The 117xA family of probes will connect directly to the Wedge probe adapter for an easy hands-free solution for probing 0.5 and 0.65 mm IC packages. See page 87 for more information.



Easy hands-free connection to fine pitch ICs using the Wedge and 117x probe.

All probes come complete with a range of accessories for both general purpose probing and the probing of fine pitch ICs and dense circuit boards.

The 117x family of probes is compatible with the AutoProbe Interface, which completely configures the Infiniium Oscilloscope for the probe.

Model	Length	Division Ratio	Circuit Loading	System Bandwidth (Scope and Probe)	Oscilloscope Input
1171A	1.4 m	10:1	10 MOhm; 10 pF	500 MHz	1 MOhm; 12 – 14 pF

117x Family Replacement Parts

Ordering Information

Fine Pitch IC Probing Accessories

E2613A Wedge probe adapter, 0.5 mm, 3-signal, qty1
E2613B Wedge probe adapter, 0.5 mm, 3-signal, qty2
E2614A Wedge probe adapter, 0.5 mm, 8-signal, qty1
E2615A Wedge probe adapter, 0.65 mm, 3-signal qty1
E2615B Wedge probe adapter, 0.65 mm, 3-signal, qty2
E2616A Wedge probe adapter, 0.65 mm, 8-signal, qty1
E2643A Wedge probe adapter, 0.5 mm, 16-signal, qty1
E2644A Wedge probe adapter, 0.65 mm, 16-signal, qty1
10467-68701 0.5 mm IC clips for surface SMT parts with leg spacing of 0.5 mm (0.020 in) to 0.8 mm (0.32 in), qty 4

Other Accessories

E9638A Probe tip to BNC adapter

Fine-Pitch Probing Kits

A Complete Solution at a Bargain Price

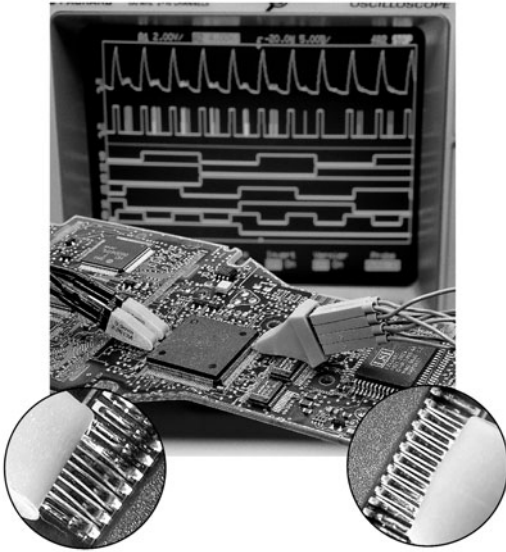
These fine-pitch probing kits take the 117x family of probes and add the most useful accessories to give you a versatile and complete probing solution. Each kit includes 2 117x-family probes (20:1 models) and related accessories, 2 of the 0.5 mm Wedge probe adapter, 4 of our 0.5 mm IC clips and 10 standard IC clips. All for a price substantially less than the individual parts.

Ordering Information

E2652A Fine-Pitch Probing Kit for the Infiniium Oscilloscopes

E2653A Fine-Pitch Probing Kit for Infiniium Oscilloscopes

- Easy connection to 0.5 mm, 0.65 mm TQFP and PQFP packages
- Reliable contact with little chance of shorting to adjacent pins
- Mechanically noninvasive
- Can be inserted while the board is active
- 3, 8, and 16-signal versions



At one end, Wedge conductor segments are inserted into the space between IC pins; at the other end, they easily connect to scopes and logic analyzers.

Wedge Probe Adapter

Precise Problem-free Probing

The Agilent Wedge probe adapter solves the problem of connecting your scope or logic analyzer to fine pitch thin quad flat pack (TQFP) and plastic quad flat pack (PQFP) surface mount ICs. It provides accurate, mechanically noninvasive and reliable electrical contact to 0.5 and 0.65 mm IC packages, with little chance of shorting. It is available in 3-, 8-, and 16-signal versions.

Easy to Insert, Then Stays Put

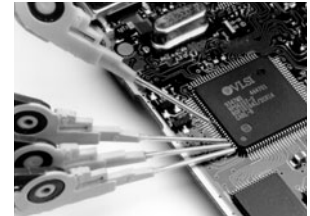
It works by inserting compressible dual conductors between adjacent IC pins. The flexible conductors conform to the size and shape of each leg to ensure tight contact. It's then a simple matter to connect your scope or logic analyzer to the Agilent Wedge.

Electrical Reliability

The Wedge's unique design delivers secure redundant contact on each pin, with little chance of shorting to adjacent pins. The redundant physical connection created by two contact points on each pin of the IC and its short electrical length dramatically increases the reliability of the electrical connection. Since the Agilent Wedge doesn't latch directly onto the IC and doesn't require expansion beforehand (as a clip does), it can be inserted while the board is active. Plus, it's mechanically noninvasive so it won't damage your device under test.



3- and 8-signal versions for 0.5 and 0.65 mm IC Packages.



10467-68701 0.5 mm IC Clips.

0.5 mm IC Clips

These IC clips are the smallest in the industry to date and are suitable for connecting to PQFP and SOIC SMT packages from 0.5 – 0.8 mm pitch. The thin body allows clips to be mounted side by side for probing adjacent IC pins. They are suitable for use with all Agilent oscilloscope probes and logic analyzers and have a maximum input voltage of ± 40 V (dc + peak ac).



10467-68701 0.5 mm IC Clips.

10075A and 10467-68701 0.5 mm IC Clip Accessory Kit

The 10075A includes four 0.5 mm IC clips (10467-68701) and two dual-lead adapters for use with passive probes. Plug the probe tip into one end of the adapter and connect the IC clip to the other end.

The 10075A is compatible with the 10070A family of passive probes. The 10467-68701 is compatible with the 10400A family of passive probes. The 1160A and 10400B family of probes include a dual-lead adapter as a standard accessory. For these probes the accessory kit is not required.

Ordering Information

- E2613A** Wedge probe adapter, 0.5 mm 3-signal, qty 1
- E2613B** Wedge probe adapter, 0.5 mm 3-signal, qty 2
- E2614A** Wedge probe adapter, 0.5 mm 8-signal, qty 1
- E2615A** Wedge probe adapter, 0.65 mm 3-signal, qty 1
- E2615B** Wedge probe adapter, 0.65 mm 3-signal, qty 2
- E2616A** Wedge probe adapter, 0.65 mm 8-signal, qty 1
- E2643A** Wedge probe adapter, 0.5 mm 16-signal, qty 1
- E2644A** Wedge probe adapter, 0.65 mm 16-signal, qty 1
- 10467-68701** 0.5 mm IC Clips, qty 4
- 10072A** SMT Probe Accessory Kit

10072A SMT Probe Accessory Kit

The 10072A includes 10 SMT lead clips that adapt the 10070A family of low-cost probes to fine-pitch devices.



Oscilloscope Probes & Accessories

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Differential Probes

1141A
1142A
1153A
N2772A
N2773A



1141A Differential Probe with 1142A Power Supply

The 1141A is a 1X FET differential probe with 200 MHz bandwidth and a 3000:1 CMRR (Common Mode Rejection Ratio). The probe has a high-input resistance and low-input capacitance of 7 pF to minimize circuit loading. The 1141A must be used with the 1142A probe control and power module, which controls input coupling modes dc, dc with variable offset, and dc reject. Two attenuators, 10X and 100X, are provided to expand the linear differential input range to ± 30 V.



N2772A Differential Probe with N2773A Power Supply

The N2772A is an active differential probe compatible with any oscilloscope with a high-impedance BNC input. With 20 MHz bandwidth and switchable attenuation of 20:1 and 200:1, N2772A provides the versatility for a broad range of applications including high-voltage circuits, motor speed controls, power supply design, electronic high-power converters, and numerous other situations where signals are floating above earth ground.

The N2772A differential probe has an input impedance of 10 MOhm and the CMRR is >50 dB at 1 MHz.

The probe requires a 9 V dc battery or N2773A power supply. The power supply has selectable ac frequency settings for 115 V and 230 Vac at 50 Hz, 60 Hz, and 400 Hz.

Ordering Information

1141A 200 MHz Differential Probe
1142A Power Supply for 1141A/1144A/1145A
1153A 200 MHz Differential Probe
N2772A 20 MHz Differential Probe
N2773A Power Supply for N2772A

3



1153A 200 MHz Differential Probe

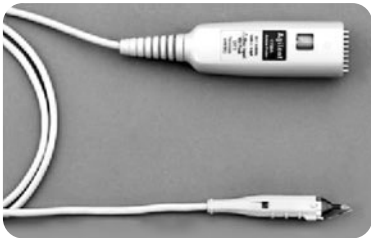
The 1153A is a 200 MHz Differential Probe for use with Agilent Infiniium Oscilloscopes. It is a 1X FET differential probe with 200 MHz bandwidth and 3000:1 CMRR (Common Mode Rejection Ratio). The probe has high-input resistance of 1 MOhm and low-input capacitance of 7 pF to minimize circuit loading. The 1153A is compatible with the AutoProbe Interface, which provides power and completely configures the Infiniium Oscilloscope for the probe.

Input coupling modes include dc, dc with variable offset, and 1 f reject. Two attenuators, 10X and 100X, are provided to expand the linear differential input range to ± 30 V.



1155A Low Mass Active Probe for Surface-Mount Devices

The two-channel 1155A low mass active probe for Infiniium oscilloscopes has a probe tip that weighs less than 1 gram making it ideal for attaching to fine pitch ICs and probing surface mount components. The probe combines high bandwidth (750 MHz), low input capacitance (2 pF), and high input resistance (1 MOhm). A versatile set of accessories are provided, including an Agilent browser with a crown point that digs deep in to solder and a spring loaded tip that helps absorb small movements. When used in conjunction with the Agilent Wedge, the 1155A provides a hands-free solution for probing 0.5 mm and 0.65 mm IC packages. See page 87 for more information.



1156A/57A/58A Active Probe, 1.5/2.5/4.0 GHz

The Agilent 1156A, 1157A, and 1158A family of active probes offers R & D engineers the performance they need to probe small geometries in hard-to-reach areas on the DUT. These probes were designed specifically for the Infiniium or 6000 Series oscilloscopes.

As the speeds in your design increase, you may notice more overshoot, ringing, and other perturbations when connecting an oscilloscope probe. Probes form a resonant circuit where they connect to the device. If this resonance is within the bandwidth of the oscilloscope probe you are using, it will be difficult to determine if the measurement perturbations are due to your circuit or the probe.

Agilent is the only company that has overcome the resonance formed by the connection of a probe to a device. The Agilent 1156/57/58A probes optimize performance to make your job easier.



1144A 800 MHz Active Probe

The 1144A features 800-MHz bandwidth, 1 MΩ input resistance, 2 pF input capacitance, 10:1 attenuation, and ±40 Vdc + peak ac maximum-input voltage. The 1144A can access power directly from the 54520 and 54540 series and the 54615B and 54616B oscilloscopes. These oscilloscopes provide power for two channels of active probing. If four channels of probing are needed, a special one-input, two-output adapter is available (p/n 01144-61604). Two adapters are needed for four channels of probing. If the 1144A is used with any scope not listed above, then the 1142A power supply is required. The 01144-61604 adapter can be used with this power supply to provide power for two channels of active probing.



InfiniiMax 113xA Probing System

InfiniiMax High-Performance Active Probe System

The innovative InfiniiMax probing system provides either differential or single-ended probing solutions for the most demanding mechanical requirements, without sacrificing performance. A flat frequency response over the entire probe bandwidth eliminates the distortion and frequency-dependent loading effects that are present in probes that have an in-band resonance.

Agilent 1130 Series InfiniiMax Probing Selection Guide

	1134A	1132A	1131A	1130A	1168A	1169A	E2669A	E2667A
Bandwidth	7 GHz	5 GHz	3.5 GHz	1.5 GHz	10 GHz	12 GHz (13 GHz typical)	Differential kit	Single-ended kit
Description	Probe amplifier, order one or both of the connectivity kits per probe amplifier				Probe amplifier, order one or both of the connectivity kits per probe amplifier		Connectivity kit, includes browser, solder-in and socket probe heads supporting the measurement type	
Oscilloscope Compatibility	54855A	54854A	54845B/ 54846B/ 54853A	5483xB/D, 6000 Series, 8000 Series	DSO80804B, DSO81004B	DSO81204B, DSO81304B	—	—
Notes	Probe amplifier specifications: dynamic range = ±2.5 V DC, offset range = ±12 V				Probe amplifier specifications: dynamic range = ±1.65 V differential, 3.3 V single ended		Probe amplifier specifications: dynamic range = ±2.5 V DC, offset range = ±12 V	



1145A Low Mass Active Probe for Surface-Mount Devices

The two-channel 1145A low mass active probe has a probe tip that weighs less than 1 gram making it ideal for attaching to fine pitch ICs and probing surface mount components. The probe combines high bandwidth (750 MHz), low input capacitance (2 pF) and high input resistance (1 MOhm). A versatile set of accessories are provided and when used in conjunction with the Wedge, the 1145A provides a hands-free solution for probing 0.5 mm and 0.65 mm IC packages. See page 87 for more information.

This probe can access power directly from the 54520/40 series and 54615/16B oscilloscopes. The 1142A power supply is required for all other instruments. This configuration requires 50 Ohm inputs.

Ordering Information

- 1130A** 1.5 GHz InfiniiMax Active Probe System
- 1131A** 3.5 GHz InfiniiMax Active Probe System
- 1132A** 5 GHz InfiniiMax Active Probe System
- 1133A** 7 GHz InfiniiMax Active Probe System
- 1142A** Power Supply for 1144A and 1145A
- 1143A** Probe Offset and Power Module for 54701A
- 1144A** 800 MHz Active Probe
- 1145A** 2-Channel, 750 MHz Active Probe
- 1155A** 2-Channel, 750 MHz Active Probe with Auto Probe Interface
- 1156A** 1.5 GHz Active Probe
- 1157A** 2.5 GHz Active Probe
- 1158A** 4 GHz Active Probe
- 1168A** 10 GHz InfiniiMax II Active Probe System
- 1169A** 12 GHz InfiniiMax II Active Probe System



10076A 100:1 High-Voltage Probe

The 10076A 4 kV 100:1 passive probe gives you the voltage and bandwidth you need for making high-voltage measurements. Its compact design makes it easier to probe today's small power electronics components and its rugged construction means it can withstand rough handling without breaking. You can measure dc voltages up to 4 kV peak. The 250 MHz probe bandwidth enables you to capture fast, high-voltage signals. The 10077A accessory kit can be used with this high voltage probe for wider range of application.



N2771A 1000:1 High-Voltage Probe

The N2771A is a new 1000:1 high voltage probe for the measurement of fast high voltage signals, up to 30 kV dc + peak ac, 10 kV_{rms} and 50 MHz probe bandwidth.

The probe's large size and rugged construction provides superior protection. The ground lead is fed through the body of the probe and protrudes behind the safety barrier, keeping the ground connection away from the high voltage.



54006A 6-GHz Passive Divider Probe

The low 0.25 pF input capacitance and sophisticated ground design of the 54006A probe lets you probe multi-GHz systems with minimal loading of the circuit under test. The small size of this probe also allows you to access very small components. The 54006A is supplied with 10:1, 500 Ω , and 20:1, 1 k Ω resistive dividers.



1146A Oscilloscope AC/DC Current Probe

This ac/dc current probe expands oscilloscope applications into industrial, automotive or power environments, and is ideal for analysis and measurement of distorted current waveforms and harmonics. This probe permits accurate display and measurement of currents from 100 mA to 100 A rms, dc to 100 kHz without breaking into the circuit. The 1146A uses Hall-effect technology to measure ac and dc signals. Compatible with any scope or voltage measuring instrument with BNC input, 0.2 to 0.5 V/div, and a minimum input impedance of 1 MOhm. 1 mV/100 mA Range; Output Signal: 10 mV/A ac/dc. 1mV/10 mA Range; Output Signal: 100 mV/A ac/dc. Working Voltage: 660 V max., Battery: 9 V alkaline.

1146A
1147A
10076A
10077A
54006A
N2771A
N2779A
N2780A
N2781A
N2782A
N2783A

Oscilloscope Probes & Accessories

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High-Voltage, Resistive Divider and Current Probes (cont.)

- Various bandwidths: DC to 2 MHz, 10 MHz, 50 MHz, 100 MHz
- DC and AC measurements
- Superior 1% accuracy and high signal-to-noise ratio
- Overload-protect function prevents probe damage from excessive input
- Direct connection to high-impedance 1 M Ω BNC input of oscilloscope
- “Demagnetize” button to remove any residual magnetism that builds up in the magnetic core
- External power supply (N2779A) lets you connect up to three N278xA current probes to a single power supply



Compatible with any oscilloscope with a high-impedance BNC input, the new N2780A Series current probes offer accurate and reliable solution for measuring DC and AC currents.

Key Literature & Web Link

www.agilent.com/find/N2780A

Hybrid Technology for AC and DC Measurements

Using hybrid technology that includes a Hall-effect sensor and an AC current transformer, the probes provide accurate measurement of DC or AC currents up to 500 Arms peak (for model N2780A) or DC – 100 MHz (for model N2783A), without breaking into the circuit. Using split core construction, the probe easily clips on and off of a conductor.

Ordering Information

N2780A 2 MHz/500 A AC/DC Current Probe
N2781A 10 MHz/150 A AC/DC Current Probe
N2782A 50 MHz/50 A AC/DC Current Probe
N2783A 100 MHz/50 A AC/DC Current Probe
N2779A 3-channel Power Supply for N2780A Series Current Probes

Wide Range of Applications

The current probes feature broad measurement ranges (up to 500 A), flat frequency response, low noise and low insertion loss that make the probes ideal for current measurements in areas such as measuring steady state or transient current of motor drives, switching power supplies, inverters, controllers, sensors, disk drives, LCD displays, electronic ballasts and amplifiers. The high signal-to-noise ratio of the N2782A and N2783A makes them ideal for making low-level current measurements in milliamphere ranges.

Accurate Current Measurement

A built-in DEMAG (demagnetize) function allows the removal of any residual magnetism that has built up in the magnetic core due to power on/off switching or excessive input current. In addition, voltage offset or temperature drift on the probe can be easily corrected by using the zero adjustment control.



1147A 50 MHz Current Probe

The Agilent 1147A is a wide bandwidth, active current probe for 8000 Series Infiniium oscilloscopes or the 5000/6000 Series oscilloscopes with AutoProbe interface. The probe features flat bandwidth (DC – 50 MHz), low noise (<2.5 mA rms) and low circuit insertion loss. The 1147A is ideal for capturing transient current signals such as those found in motor controllers, in switching power supplies, inverters and current amplifiers driving inductive loads.

1146A
1147A
10076A
10077A
54006A
N2771A
N2779A
N2780A
N2781A
N2782A
N2783A

Related Literature

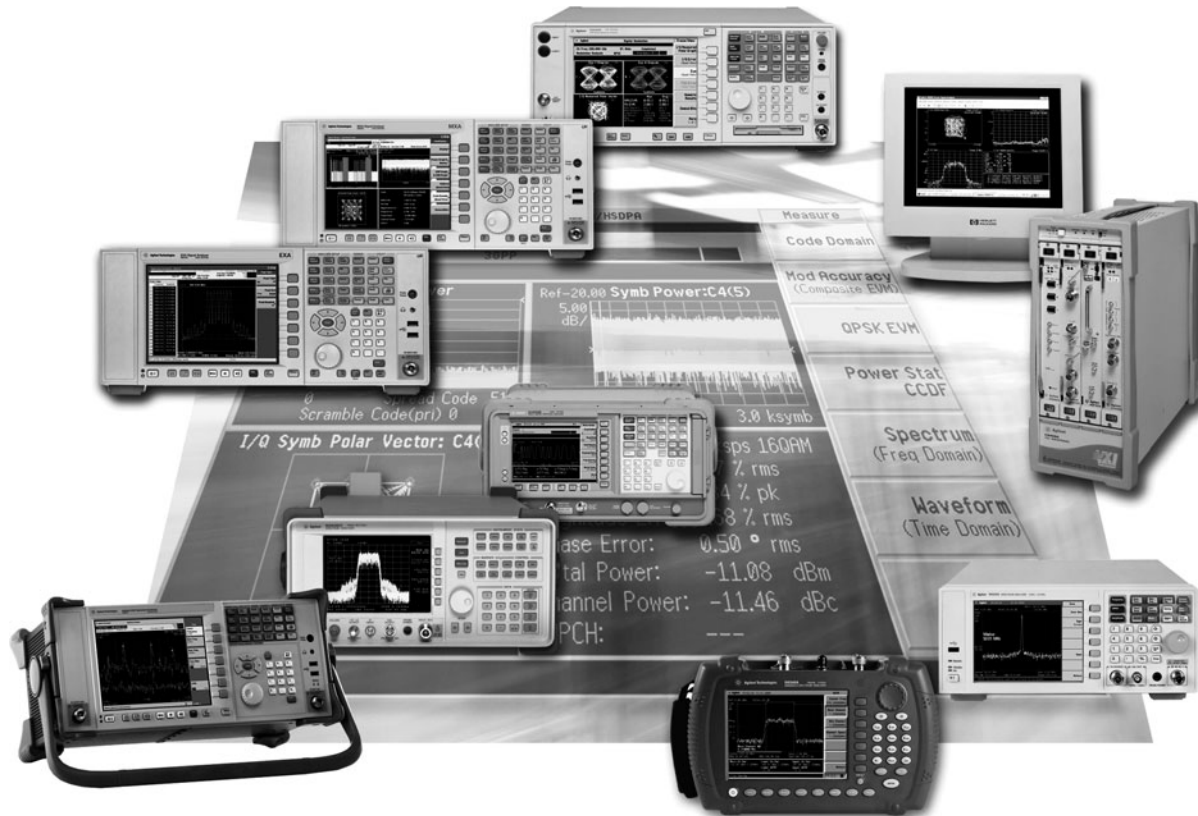
Publication Title	Publication Type	Publication Number
Agilent Oscilloscope Probes and Accessories	Selection Guide	5989-6162EN
Agilent 3000 Series Oscilloscopes	Data Sheet	5989-2235EN
Agilent 5000 Series Portable Oscilloscopes	Data Sheet	5989-6110EN
Agilent Technologies 6000 Series Oscilloscopes	Data Sheet	5968-8152EN
Agilent Technologies Infiniium 8000 Series Oscilloscopes	Brochure	5988-3788EN
Infiniium DSO80000B Series Oscilloscopes and InfiniiMax Probes	Data Sheet	5989-4604EN
Infiniium 86100B DCA: Modular Platform for Fast, Accurate Waveform Testing Up to 40 Gb/s	Brochure	5988-5235EN

The following literature provides useful information on using oscilloscopes for specific applications.

Optimizing Oscilloscope Measurement Accuracy on High-Performance Systems with Agilent Active Probes	Application Note 1385	5988-5021EN
Ten Things to Consider When Selecting your Next Oscilloscope	Application Note	5989-0552EN
Five Applications to Help you Decide	Application Note	5989-0526EN
Finding Hidden Problems Using Agilent's Deep-Memory Oscilloscope: How IBM Solved a Mystery	Customer Success Story	5988-5655EN
The Truth About the Fidelity of High-Bandwidth Voltage Probes	Application Note 1404	5988-6515EN
The Next Generation in Automated Oscilloscope Test	Application Note	5989-5989EN
Evaluating Oscilloscope Sample Rates vs. Sampling Fidelity: Accurate Digital Measurements	Application Note	5989-5732EN
Improve your Ability to Capture Elusive Events	Application Note	5989-2002EN
Deep Memory Oscilloscopes: The New Tools of Choice	Application Note	5989-9106EN
Using Scope's Segmented Memory to Capture Signals More Efficiently	Application Note	5989-4932EN
Debugging Serial Bus Systems with a Mixed-Signal Oscilloscope	Application Note 1395	5988-5997EN
Agilent Infiniium Oscilloscopes Performance Guide Using 89601A Vector Signal Analyzer Software	Product Note	5988-4096EN

Ordering Information

1146A 100-kHz AC/DC Current Probe
10076A 100:1 High Voltage Probe
10077A Accessory Kit for 10076A
54006A 6-GHz Passive Divider Probe
N2771A 1000:1 High Voltage Probe



Agilent Technologies offers a complete line of analyzers to provide frequency, time, order, angle, and modulation-domain measurement capability. The following section is devoted primarily to the frequency domain.

Signal/Spectrum Analyzers

Modern day analyzers offer both swept-tuned and FFT architectures. In addition they also offer high frequency range, wide dynamic range, and excellent overall RF characteristics. Many offer measurement personalities and applications to demodulate signals based on standards, and can be configured with easy to use one-button pass/fail testing capabilities. The following are just some of the measurements that can be made with signal/spectrum analyzers: absolute and relative frequency, absolute and relative amplitude, noise, spurious and distortion products, AM, FM, pulsed modulation, and digital modulation.

Dynamic Signal (Fourier) Analyzers

Fourier analyzers offer fast, high-resolution spectrum and network analysis. Unlike conventional swept analyzers, Fourier-based analyzers can measure dynamic signals because they measure all frequencies simultaneously, not one at a time. Fourier analyzers are especially useful on low-frequency signals (<100 kHz) or where very fast measurements are desired. Applications include acoustic, modal, vibration, or rotating machine analysis.

Vector Signal Analyzers

VSAs provide capabilities throughout the RF range. They offer fast, high-resolution spectrum measurements, demodulation, and advanced time-domain analysis. They are especially useful for characterizing complex signals such as burst, transient, or modulated signals used in communications, video, broadcast, sonar, and ultrasound imaging applications. The vector signal analyzer is also capable of in-depth modulation analysis as it captures signal phase along with magnitude.

EMC/EMI Solutions

Based on a spectrum analyzer platform the E7400A series EMC analyzer provides the tools required for pre-compliance EMI measurements to 26.5 GHz for conducted and radiated emissions.

Using any of the PSA Series spectrum analyzers as the measurement engine, the EMI Measurement Receiver adds the N9039A RF Pre-selector for full CISPR 16-1-1 compliance measurement capability.

Overview

Below you will find a condensed comparison guide of Agilent Signal/Spectrum Analyzers. For the full signal/spectrum analyzer capabilities, please see their individual web pages at www.agilent.com or their respective sections in this catalog.

	PSA	MXA	856x	EXA	ESA-E	ESA-L	CSA	Low Cost	Handheld
	E444xA	N9020A		N9010A	E440xB	E44xxB	N1996A	N9320A	N9340A
Price/Performance	*****	****	****	***	***	**	**	**	**
Frequency Range	3 Hz – 50 GHz	20 Hz – 26.5 GHz	30 Hz – 50 GHz	9 kHz – 26.5 GHz	100 Hz ¹ – 26.5 GHz	9 kHz – 26.5 GHz	100 kHz – 6 GHz	9 kHz – 3 GHz	100 kHz – 3 GHz
Minimum RF Sweep Time	1 ms	1 ms	50 ms	1 ms	1ms	4 ms	180 ms	9.2 ms	10 ms
Warm-Up Time	30 mins	30 mins	5 mins	30 mins	5 mins	5 mins	5 mins	45 mins	30 mins
Phase Noise at 1GHz (10 kHz Offset)	–116 dBc/Hz	–103 dBc/Hz	–113 dBc/Hz	–99 dBc/Hz	–98 dBc/Hz	–90 dBc/Hz	–85 dBc/Hz	–88 dBc/Hz	–87 dBc/Hz
Maximum Third Order Dynamic Range, 1 GHz	113 dB	110 dB	108 dB	106 dB	108 dB	88 dB	96 dB	93 dB	89 dB
Displayed Average Noise at 1 GHz	–168 dBm ²	–163 dBm ²	–151 dBm ¹	–160 dBm ²	–166 dBm ^{2,3}	–125 dBm ¹	–146 dBm ^{2,3}	–148 dBm ²	–144 dBm ²
Standard Attenuator Range/Step	70 dB 2 dB	70 dB 2 dB	70 dB 10 dB	60 dB 10 dB	75 dB 5 dB	65 dB 5 dB	40 dB 1 dB	70 dB 1 dB	51 dB 1 dB
Overall Amplitude Accuracy	±.62 dB	±.78 dB	±1.9 dB	±.95 dB	±1.0 dB	±1.1 dB	±1.5 dB	±2.0 dB	±1.5 dB
Resolution Bandwidth	1 Hz – 8 MHz	1 Hz – 8 MHz	1 Hz – 2 MHz	1 Hz – 8 MHz	1 Hz – 5 MHz	100 Hz – 5 MHz	10 Hz – 5 MHz	10 Hz – 1 MHz	30 Hz – 1 MHz
Standard Analysis Bandwidth	10 MHz	10 MHz		10 MHz	10 MHz		5 MHz		1 MHz
Optional Analysis Bandwidth	40 MHz 80 MHz	25 MHz							
Battery					• ¹	• ¹	• ¹		standard

¹ Optional.

² With optional built-in preamp.

³ Typical.

Power Suite One-button Measurements

	PSA	MXA	856x	EXA	ESA-E	ESA-L	CSA	N9320A	N9340A
Channel Power	•	•	•	•	•	•	• ²	•	•
Occupied Bandwidth	•	•	•	•	•	•	•	•	•
Multicarrier, Multi-offset ACP	•	•	• ¹	•	•	•	•	•	•
Multicarrier Power	•	•	• ¹	•	•	•			
CCDF	•	•		•	•				
Harmonic Distortion	•	• ²		• ²	•	•			
Burst Power	•	•		•	•	•			
Intermod (TOI)	•	• ²		• ²	•	•		•	
Spurious Emissions	•	•		•	•	•			
Spectrum Emission Mask	•	•		•	•	•		•	

¹ Option.

² Future Option.

Measurement Applications and Personalities

Below is a short comparison of measurement applications and personalities on our Spectrum/Signal Analyzers. Please see the individual listings in subsequent chapters for a complete list of capabilities that each analyzer offers.

	PSA	MXA	856xEC	EXA	ESA-E	ESA-L	CSA	N9320A	N9340A
Cable TV						•			
Cable Fault Location					•		•		
cdma2000	•	• ²		• ²					
EMI Precompliance	•								
External Source Control	•	• ²		• ²					
Flexible Digital Mod Analysis	•	• ²		• ²	•				
GSM/EDGE	•	• ²		• ²	•				
Noise Figure	•	• ²		• ²	•				
Phase Noise	•	•	•	•	•				
TD-SCDMA	•	• ²		• ²					
W-CDMA HSDPA/HSUPA	•	•		•					
WiMAX Mobile	• ³	•		•					
WiMAX Fixed	• ³	• ³		• ³					
AM/FM Tune and Listen		• ²		• ²			•		•
WLAN	•	• ³		• ³					
1xEV-DO	•	• ²		• ²					
856x, 859x Programming Code Compatibility Suite	•	• ²		• ²					
Stimulus Response							•		
89601A Link	•	•		•	•				

Connectivity

Remote Interface

RS-232

					• ¹	• ¹			
GPIB	•	•	•	•	•	•			
LAN	10	100		100			100		
USB	2.0 ⁴	2.0		2.0			1.1	1.1	1.1
Removable storage	3.5" floppy	USB	Memory card	USB	3.5" floppy	3.5" floppy	USB	USB	USB
LXI		B ² , C		B ² , C					

¹ Option.² Future Option.³ With 89601A VSA software.⁴ Device-side only.

For complementary signal generation software, see Signal Generators – Signal Studio Software on page 311.

Dynamic Signal Analyzers

Frequency Range	Channel Match	Frequency Resolution in Lines	Real-time Bandwidth	Dynamic Range	Amplitude Accuracy* (\pm)	Model Number	Page
0.000122 Hz to 102.4 kHz	± 0.04 dB, $\pm 0.5^\circ$	100 to 1600	25.6 kHz	80 dB (90 dB typical)	0.15 dB	35670A	270

*Relative accuracy = relative frequency response + lesser of either scale fidelity or IF gain accuracy.

Vector Signal Analyzers

Frequency Range	Maximum Analysis Bandwidth	Sensitivity (displayed average noise level)	Dynamic Range (3 rd order IMD)	Modulation Analysis	Signal Capture Memory	Model Number	Page
3 Hz to 50 GHz*	Up to 13 GHz*	-168 dBm/Hz* (at 1 GHz)	-75 dBc*	PC software linked to ESA, PSA, MXA, EXA analyzers or Infiniium series oscilloscopes. Flexible, in-depth digital demodulation (>30 demodulators) and >25 wireless format-based measurement setups.	Up to 1.2 GB (384 Msa, complex)	89601A	124
dc to 40 MHz	39 MHz	-151 dBm/Hz	-70 dBc**	Flexible, in-depth digital demodulation (>30 demodulators) and >25 wireless format-based measurement setups	Up to 1.2 GB (384 Msa, complex)	89610S	126
52 to 88 MHz (or frequency range of external tuner)	36 MHz	-159 dBm/Hz	-70 dBc**	Flexible, in-depth digital demodulation (>30 demodulators) and >25 wireless format-based measurement setups	Up to 1.2 GB (384 Msa, complex)	89611S	126
dc to 2.7 GHz	36 MHz	-158 dBm/Hz (at 1 GHz)	-70 dBc**	Flexible, in-depth digital demodulation (>30 demodulators) and >25 wireless format-based measurement setups	Up to 1.2 GB (384 Msa, complex)	89640S	126
dc to 6 GHz	36 MHz	-157 dBm/Hz (at 1 GHz)	-70 dBc**	Flexible, in-depth digital demodulation (>30 demodulators) and >25 wireless format-based measurement setups	Up to 1.2 GB (384 Msa, complex)	89641S	126
3 Hz to 6.7, 13.2, 26.5 GHz	40, 80 MHz	-152 dBm/Hz	<-78 dBc, typical	Flexible, in-depth digital demodulation (>30 demodulators) and >25 wireless format-based measurement setups	512 MB (128 Msa, complex)	89650S	125

* Depends on analyzers or oscilloscopes linked to 89601A PC software.

** 2 tones at 6 dB below full scale (-31 dBm at input).

Signal Source Analyzer/Phase Noise Measurement Solutions

Frequency Range	Phase Noise Sensitivity (depends on offset frequency)	Functions Available	Model Number	Page
10 MHz to 7 GHz/ 26.5 GHz*/110 GHz**	-135 dBc/Hz @1 kHz offset to -178 dBc/Hz @10 MHz offset (@1 GHz, SPD)	Phase noise, frequency, RF power, DC current, frequency/phase/power transient, AM noise, Baseband noise	E5052B	268
50 kHz to 110 GHz ²	-180 dBc/Hz @>10 kHz offset (typical)	Phase noise, AM noise, residual noise, low level spurious signals: 0.01 Hz to 100 MHz offsets	E5505A	553

* with E5053A

** with external mixers

Measuring Receiver – Signal Generator and Attenuator Calibration

Frequency Range	Maximum Amplitude Measurement Range	Functions Available	Model Number	Page
100 kHz to 50 GHz	+30 dBm to -140 dBm	Frequency counter, absolute RF power, tuned RF level, AM depth, FM/PM deviation, modulation rate, modulation distortion, and audio signal analysis (optional)	N5531S	108

EMC Analyzers

Frequency Range	Maximum Sensitivity (displayed average noise level)	Maximum Dynamic Range 3rd order	Amplitude Accuracy (\pm)	Resolution Bandwidth Range	Model Number	Page
100 Hz to 3.0 GHz	≤ -150 dBm ²	+12.5 dBm TOI	1.0 dB	1 Hz to 5 MHz (including 200 Hz, 9 kHz, 120 kHz, 1 MHz EMI BW)	E7402A	142
100 Hz to 26.5 GHz	≤ -150 dBm ²	+12.5 dBm TOI	1.0 dB	1 Hz to 5 MHz (including 200 Hz, 9 kHz, 120 kHz, 1 MHz EMI BW)	E7405A	142

¹ With standard built-in pre-amplifier.

² To 110 GHz with external mixing.

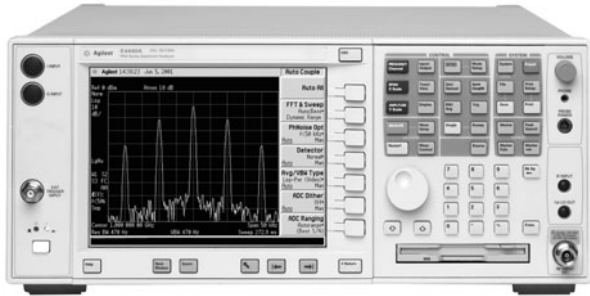
EMI Measurement Receiver

Frequency Range	Amplitude Accuracy	Frequency Accuracy	Functions Available	Model Number	Page
3 Hz to 6.7, 13.2, 26.5, 44, or 50 GHz	<1.0 dB (9 kHz to 1 GHz)	<0.2% Typical <0.02%	CISPR 16 & Mil Std 461 detectors and bandwidths. Limit lines, amplitude corrections, zoom display, measure at marker	N9039A ¹	141

¹ When used with PSA series spectrum analyzer and PSA option 239 EMI Receiver measurement personality.

E4443A
E4445A
E4440A
E4447A
E4446A
E4448A

- All-digital IF gives industry-leading accuracy and linearity
- Exceptionally fast low-level spur search
- One-button RF power measurements with format-based setups
- Over 16 optional built-in measurement personalities for phase noise, noise figure and 2G through 3.5G digital modulation formats
- Optional 80 MHz analysis bandwidth with unsurpassed dynamic range and flatness



PSA Series Spectrum Analyzer

PSA Series High-Performance Spectrum Analyzer

3

The Agilent PSA series offers high-performance spectrum analysis up to 50 GHz with powerful one-button measurements, a versatile feature set, and a leading-edge combination of flexibility, speed, accuracy, bandwidth and dynamic range.

Measurement Accuracy

The PSA Series' modern instrument architecture features an all-digital IF section, a highly accurate internal reference signal, and automatic internal alignment processes to achieve unsurpassed industry-leading accuracy, guaranteed by Agilent's high standards for meeting our published specifications.

Measurement Speed and Dynamic Range

The PSA Series spectrum analyzer is designed to optimize measurements for speed and dynamic range. With a 2-dB step attenuator and 160 resolution bandwidth settings (in 10% steps), you can customize each of your measurements to achieve the best combination of speed and dynamic range. Decrease adjacent channel power ratio measurement time with the industry's fastest ACPR measurement.

Swept Tuned or FFT Analysis

With the all-digital IF, the PSA can perform both swept or FFT measurements. FFT capability can significantly reduce the sweep time in narrow span measurements and low-level spur searches.

Analysis Bandwidth

For center frequencies up to 26.5 GHz, use PSA option 122 (80 MHz BW Digitizer) to analyze signals up to 80 MHz wide and with 78 dB of image-free dynamic range. Analysis of digitally modulated signals is enhanced by the superb digital IF performance, which produces residual EVM of <1%. Capture up to 1.28 seconds of signal data at 80 MHz bandwidth, or record longer capture times at narrower spans. For signals up to 40 MHz wide, use the PSA Option 140 (40 MHz BW Digitizer). For measurements above 3 GHz, PSA Option 123 (Switchable MW Preselector Bypass), allows for superb frequency response and phase linearity in the microwave bands.

Phase Noise Optimization

Increase the dynamic range of your close-to-carrier measurements with the phase noise optimization feature of the PSA Series. Depending on how close to or far from the carrier you are measuring, the PSA has different LO phase lock loop configurations to reduce phase noise and therefore increase the dynamic range of your measurement.

Gated Sweep

Analyze time varying signals such as pulsed RF, time division multiple access (TDMA), interleaved and burst-modulated with gated sweep capability. This type of time gating makes fast spectrum measurements on burst signals without interference from switching the carrier on and off.

EMC

Use the PSA to make conducted and radiated emissions measurements. Now available in every PSA are built-in CISPR and MIL-STD compliant EMI detectors and bandwidths.

One-Button Power Measurements

The PSA Series offers a standard suite of flexible, one-button RF and microwave power measurements with format based setups. With Power Suite, measurements that were once difficult and tedious to make are now executed with a single button press and provide easy-to-read results.

One-button measurements include:

- channel power
- occupied bandwidth
- adjacent channel power (ACP), fast ACP
- multi-carrier ACP
- power statistics (CCDF)
- harmonic distortion
- burst power
- third order intercept (TOI)
- spurious emissions
- spectrum emission mask

Format-based setups for:

- | | |
|-----------------------|-------------------------|
| • IS-95A | • GSM/EDGE |
| • IS-95C | • cdma2000 |
| • 3GPP W-CDMA | • PDC |
| • NADC | • TETRA |
| • Bluetooth | • W-LAN HiperLAN/2 |
| • W-LAN (802.11a/b/g) | • UWB |
| • DVB-T | • S-DMB |
| • J-STD-008 | • FCC Part 15 Subpart F |

Measurements Beyond Spectrum Analysis

The PSA Series offers a variety of optional measurement personalities to expand measurement capability. A measurement personality is a downloadable software program that can transform the spectrum analyzer into another type of test instrument, essentially giving it another "personality". You can make the most challenging measurements very easily and with the same instrument you use for spectrum analysis. Choose from over 16 measurement personalities to make phase noise measurements for oscillator tests, measure the noise figure of your amplifier, execute scalar network analysis, or even perform modulation analysis on your 2G, 2.5G, 3G or 3.5G signal. If you have a proprietary modulated signal that you want to test, you can use internal flexible digital modulation analysis personality or you can link the PSA to the 89601A vector signal analysis software for flexible demodulation and analysis.

Connectivity

The PSA Series has built-in capability to network with PCs, printers, software programs, and test systems. Features include IVI-COM drivers for developing measurement routines and collecting results, IntuiLink connectivity software to transfer measurement results and screen captures directly into Microsoft® Excel and Word, a floppy disk drive to store results and display data, and GPIB and 10 baseT LAN for SCPI programming. Additionally, a USB 2.0 device-side I/O interface is available for the high throughput data transfer. You can also operate the analyzer remotely, anywhere in the world, using our BenchLink Web Remote control software (Option 230).

Upgrade from the HP8566A/B or HP8568A/B Analyzer

The PSA Series spectrum analyzers offer programming code compatibility with the Agilent 856x, 895x, and HP 8566A/B, 8568A/B legacy spectrum analyzers. Option 266 allows users with those legacy instruments to upgrade their automated test equipment (ATE) systems with modern and supportable ESA-E or PSA Series spectrum analyzers as the HP 8566A/B, 8568A/B instruments reach the end of their formal support lives. Additionally, PSA Option 124 provides 8566A/B, 8568A/B analog Y-axis video out capability.

Measurements Beyond 50 GHz

With optional external mixing capability (Option AYZ) along with harmonic mixers, the Agilent PSA (E4440A/46A/47A/48A) can measure signals up to 325 GHz. The PSA Option AYZ will support Agilent 11970 Series millimeter harmonic mixers, Agilent 11974 Series preselected millimeter harmonic mixers as well as third party mixers. The PSA Option AYZ offers patented signal identification methods to help you identify true signals to be test more efficiently, and amplitude correction to compensate for conversion loss incurred in external mixers. It also supplies bias voltage with adjustable current for third-party mixers requiring biasing to maximize signal conversion.

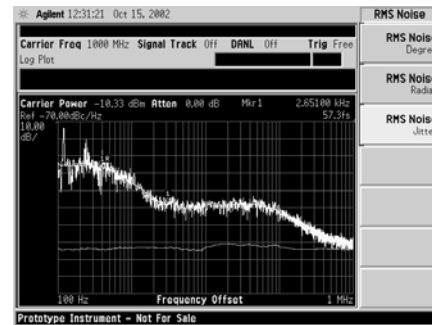
Gated Sweep

Analyze time-varying signals such as pulsed RF, time division multiple access (TDMA), interleaved and burst-modulated signals with gated sweep capability that is now a standard feature of all the PSA Series spectrum analyzers. The gated sweep capability enables the PSA to perform fast and accurate spectrum measurements on burst signals without interference from switching the carrier on and off. The gate length can be easily adjusted between 10 μ s and 500 ms, and the gate delay from 0 to 500 ms. Users can choose between external TTL trigger, variable level trigger, or burst trigger to start the PSA gated sweep according to the nature of time-varying signals under test.

External Source Control (Option 215)

The external source control measurement personality, available on all the PSA Series models (E4440A/43A/45A/46A/47A/48A), enables these high-performance spectrum analyzers to control Agilent PSG or ESG signal generators for scalar network analysis up to 50 GHz. A variety of controlled sweep modes, including standard sweep, harmonic sweep, offset sweep, and power sweep, provides the optimal test tools for characterizing different components. Wide dynamic range (up to and beyond 109 dB) allows accurate measurements for a component with the presence of high and low power levels at the same time. One-button normalization and open/short calibration help to remove the systemic frequency response errors incurred in the transmission and return loss measurements, respectively, to further improve the measurement accuracy.

Measurement Personalities

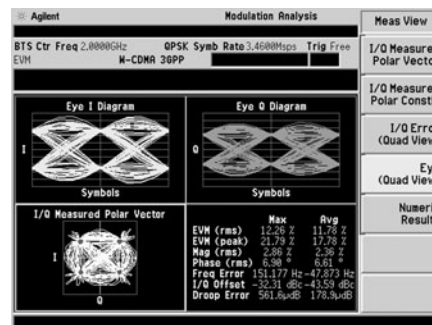


Phase Noise (Option 226)

This optional, built-in measurement personality consolidates advanced spectrum analysis capability and phase noise measurements into a single oscillator test. This flexible tool can quickly and easily generate plots of phase noise in dBc/Hz versus log offset frequency or measure jitter or make continuous real-time spot frequency phase noise measurements. An intuitive user-interface provides easily adjustable parameters without the need to resort to cumbersome tables.

Noise Figure (Option 219)

The noise figure measurement personality provides fast, one-button noise figure and gain measurements from 200 kHz up to 26.5 GHz. DUT setup menus help guide you easily through amplifier and mixer measurements, and a built-in measurement uncertainty calculator makes it easy to qualify your measurement system. An optional internal preamplifier (Option 1DS) improves instrument uncertainty to ± 0.05 dB for frequencies up to 3 GHz, so you can conveniently and accurately measure devices with low noise figure. A 50 GHz internal preamplifier (Option 110) enables nominal performance to the highest frequency of the PSA.



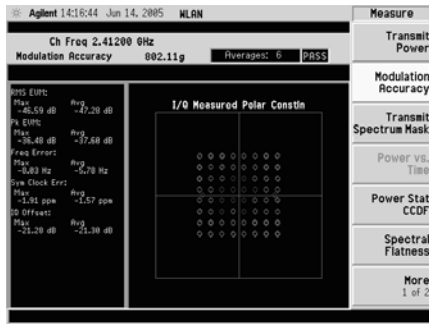
Flexible Digital Modulation Analysis (Option 241)

The flexible digital modulation analysis measurement personality allows you to measure error vector magnitude (EVM), and troubleshooting digital communication systems. This option makes PSA as a single analyzer for spectrum and modulation analysis with a variety of digital modulation formats including industry standard formats such as: IS-95 (cdmaOne), cdma2000, W-CDMA, EDGE/GSM, NADC, PDC, PHS, Bluetooth, TETRA, ZigBee, APCO25 Phase1, and VDL mode3. If you are working with customized or unique formats different from existing standards, you can easily set up your own custom demodulation formats (MSK, PSK, FSK, QAM, etc.) and parameters to suit your application.

E4443A
E4445A
E4440A
E4447A
E4446A
E4448A

3

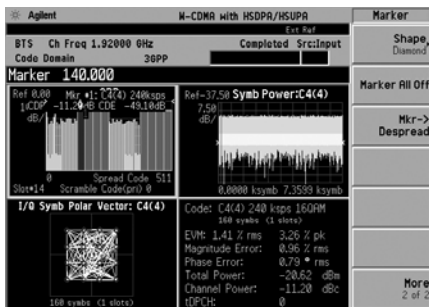
E4443A
E4445A
E4440A
E4447A
E4446A
E4448A



WLAN (Option 217)

Analyze WLAN 802.11a, 802.11b, and 802.11g signals, including DSSS, CCK, PBCC, and OFDM signals, with an easy-to-use and intuitive interface. Test IEEE-based standard conformance, or set a customized pass/fail limit. Perform signal impairment analysis using built-in modulation accuracy measurement tools. Measurements included in this option are:

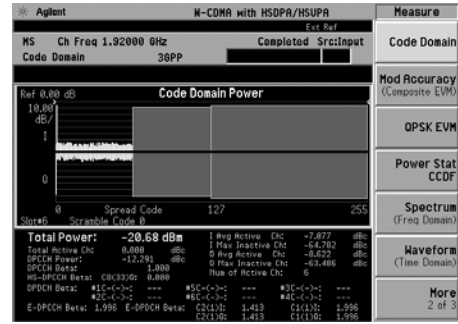
- error vector magnitude
- transmit power
- spectrum emission mask
- CCDF
- spectral flatness
- power ramp up and ramp down (802.11b only)
- center frequency leakage
- frequency and symbol clock error



W-CDMA (Option BAF)

The complexity of W-CDMA demands flexibility for 3GPP conformance test and depth of modulation analysis capability provided by this measurement personality. Perform the following standards-based measurements on the both uplink or downlink signals:

- code domain analysis
- QPSK EVM
- modulation accuracy (composite EVM)
- channel power
- adjacent channel power leakage ratio (ACLR)
- intermodulation distortion
- multi-carrier power
- spectrum emission mask
- occupied bandwidth
- CCDF
- power control (PRACH power, slot power and slot phase for UE phase discontinuity)
- power versus time



HSDPA/HSUPA (Option 210)

To follow the 3GPP standard evolving in release 5 and 6, High Speed Downlink Packed Access (HSDPA) and High Speed Uplink Packet Access (HSUPA) are added over W-CDMA 3GPP to increase the data rate for both downlink and uplink. Option 210 provides more modulation analysis capabilities like analysis for HS-PDSCH in 16QAM and HS-DPCCH for HSDPA. As for HSUPA, E-DPCCH and E-DPDCH can be demodulated for EVM and code domain analysis.

GSM with EDGE (Option 202)

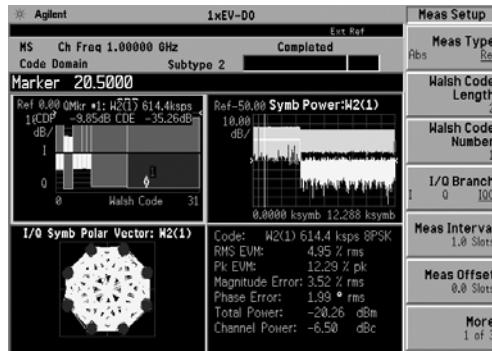
This option includes both Global System for Mobile Communications (GSM) and Enhanced Data Rates for GSM Evolution (EDGE) measurements based on the latest standards. The following measurements are quick, easy to make, and standards-based:

- transmit power
- GMSK power versus time (PvT)
- GMSK phase and frequency error
- GMSK output RF spectrum (ORFS)
- GMSK transmitter band spurious
- EDGE PvT
- EDGE EVM
- EDGE ORFS
- EDGE transmitter band spurious

cdma2000 (Option B78)

The cdma2000 measurement personality offers the logical upgrade path from IS-95 to IS-2000 testing. Measurements supported in both the forward and reverse links include:

- code domain analysis
- QPSK EVM
- modulation accuracy (composite rho and EVM)
- channel power
- adjacent channel power ratio
- intermodulation distortion
- spectrum emission mask
- occupied bandwidth
- CCDF



1xEV-DV (Option 214)

For the higher data rates provided by 1xEV-DV in cdma2000 forward link, the 1xEV-DV measurement personality supports 8PSK and 16QAM modulation analysis. This option provides the following necessary measurements:

- code domain analysis
- modulation accuracy (composite rho and EVM)

1xEV-DO (Option 204)

The evolution to cdma2000 with 1xEV-DO Rev.0 and A introduces unique measurement challenges. Based on 3GPP2 Technical Specification Group cdma2000 (TSG-C) standards (C.S0032, C.S0033 and C.S0024-A), these challenges are met with the following measurements:

- code domain power
- modulation accuracy (composite rho)
- QPSK EVM
- power versus time (PvT)
- channel power
- intermodulation distortion
- spurious emissions and ACP
- occupied bandwidth
- CCDF

TD-SCDMA (Options 211/212/213)

Perform measurements on uplink and downlink TD-SCDMA signals. The measurement personalities, based on the 3GPP TD-SCDMA standard UTRA TDD 1.28 Mcps option, provide power and modulation-domain measurements, including HSDPA/8PSK signals, with pass/fail indication for conformance verification. These limits can be user-defined to meet custom pass/fail requirements.

PSA Option 211 TD-SCDMA measurement personality easily makes power measurements such as transmit power, power versus time, occupied bandwidth, adjacent channel power, spectrum emission mask, and more.

PSA Option 212 performs modulation analysis measurements. By quickly quantifying modulation quality, engineers can troubleshoot designs and find the root cause of error. Composite EVM, constellation diagram, code domain power, code domain error, and other results are available.

PSA Option 213 adds HSDPA/8PSK capability to Option 212, allowing troubleshooting of HS-PDSCH and associated channels.

cdmaOne (Option BAC)

Built on Agilent's pioneering efforts in CDMA measurement techniques, this personality provides quick and easy measurement setups for ACPR and SpurClose with TIA/EIA/IS-95A, J-STD-008, and IS-97D/98D standards and following measurements:

- modulation accuracy (rho)
- code domain analysis
- channel power
- adjacent channel power ratio
- close-in spurious

NADC/PDC (Option BAE)

Both the North American Digital Cellular (NADC) and Personal Digital Cellular (PDC) measurement personalities are included in this option. The NADC measurements are structured according to the IS-136 TDMA standard. Measurements included in this option are:

- adjacent channel power (ACP)
- error vector magnitude (EVM)
- occupied bandwidth (available for PDC only)

Built-in Measuring Receiver Personality (Option 233)

This option is the key component that converts the general-purpose PSA Series high-performance spectrum analyzer into the flexible N5531S measuring receiver. The PSA-based measuring receiver is an ideal tool for signal generator/attenuator calibrations up to 50 GHz, with special functions including:

- Frequency counter
- Absolute RF power
- Tuned RF level
- AM depth, FM/PM deviation
- Modulation distortion
- Audio analysis (optional)

See page 108 for details about the PSA-based measuring receiver.

N9039A RF Preselector Control for EMI Receiver (Option 239)

Option 239 for the PSA is the personality enabling it to be used in conjunction with Agilent's N9039A RF Preselector to be configured as a CISPR 16-1-1 compliant EMI receiver. This personality controls the preselector during measurements and enables the alignment of the preselector to the PSA using an Agilent approved source. The personality allows the PSA to control settings within the preselector like attenuation and gain from within the PSA and minimize the need for user interaction with the preselector. The personality also provides measurements unique to the capability of the receiver like "zoom display" and "measure at marker" which allow the user to view and measure the noise characteristics of frequency suspects while in a large span.

See page 141 for details about the PSA-based EMI measurement receiver.

E4443A
E4445A
E4440A
E4447A
E4446A
E4448A

Frequency Specifications

Frequency Range

E4443A	(DC coupled) 3 Hz to 6.7 GHz
E4445A	(AC coupled) 20 MHz to 6.7 GHz
E4440A	(DC coupled) 3 Hz to 13.2 GHz
E4447A	(AC coupled) 20 MHz to 13.2 GHz
E4446A	(DC coupled) 3 Hz to 26.5 GHz
E4448A	(AC coupled) 20 MHz to 26.5 GHz
E4447A	(DC coupled) 3 Hz to 42.98 GHz
E4446A	(DC coupled) 3 Hz to 44 GHz
E4448A	(DC coupled) 3 Hz to 50 GHz

Band Harmonic Mixing Mode (N)

0	1–	3 Hz to 3 GHz
1	1–	2.85 GHz to 6.6 GHz
2	2–	6.2 GHz to 13.2 GHz
3	4–	12.8 GHz to 19.2 GHz
4	4–	18.7 GHz to 26.8 GHz
5	4+	26.4 GHz to 31.15 GHz
6	8–	31.0 GHz to 50.0 GHz

Frequency Reference

Accuracy $\pm[(\text{time since last adjustment} \times \text{aging rate}) + \text{temperature stability} + \text{calibration accuracy}]$

Aging rate $\pm 1 \times 10^{-7}/\text{year}$

Temperature stability $\pm 1 \times 10^{-8}$ (20°C to 30°C)

Calibration accuracy $\pm 5 \times 10^{-8}$ (0°C to 55°C)

Frequency Readout Accuracy (start, stop, center, marker)
 $\pm(\text{marker frequency} \times \text{frequency reference accuracy} + 0.25 \text{ percent} \times \text{span} + 5 \text{ percent} \times \text{RBW} + 2 \text{ Hz} + 0.5 \times \text{horizontal resolution}^*)$
 *Horizontal resolution is span/(sweep points – 1)

Marker Frequency Counter

Accuracy $\pm(\text{marker frequency} \times \text{frequency reference accuracy} + 0.100 \text{ Hz})$

Delta counter accuracy $\pm(\text{delta frequency} \times \text{frequency reference accuracy} + 0.141 \text{ Hz})$

Counter resolution 0.001 Hz

Frequency Span (FFT and swept mode)

Range 0 Hz (zero span), 10 Hz to maximum frequency of model

Resolution 2 Hz

Accuracy $\pm[0.2 \text{ percent} \times \text{span} + \text{span}/(\text{sweep points} - 1)]$

Sweep Time and Triggering

Range

Span = 0 Hz 1 μ s to 6000 s

Span ≥ 10 Hz 1 ms to 2000 s

Accuracy

Span ≥ 10 Hz, sweep ± 0.01 % nominal

Span ≥ 10 Hz, FFT ± 40 % nominal

Span = 0 Hz ± 0.01 % nominal

Trigger Free run, line, video, RF burst, external front, external rear

Trigger delay

Span = 0 Hz, or FFT –150 ms to +500 ms

Span ≥ 10 Hz, swept 1 μ s to 500 ms

Resolution 0.1 μ s

Sweep (trace) Point Range

Span = 0 Hz 2 to 8192

Span ≥ 10 Hz 101 to 8192

Gated FFT

Maximum span	10 MHz
Delay range	–150 to +500 ms
Delay resolution	100 ns or 4 digits whichever is more
Gate duration	1.83/RBW ± 2 % nominal

Gated Sweep

Span range	Any span
Gate length range	10.0 μ s to 500.0 ms
Gate Delay range	0 to 500.0 ms

Resolution Bandwidth (RBW)

Range (–3.01 dB bandwidth) 1 Hz to 3 MHz (10 % steps), 4, 5, 6, 8 MHz

Bandwidth accuracy (power):

RBW range:

1 Hz to 51 kHz ± 0.5 % (± 0.022 dB)

56 kHz to 100 kHz ± 1.0 % (± 0.044 dB)

110 kHz to 240 kHz ± 0.5 % (± 0.022 dB)

270 kHz to 1.1 MHz (< 3 GHz CF) ± 1.5 % (± 0.044 dB)

1.2 MHz to 2.0 MHz (< 3 GHz CF) ± 0.07 dB nominal

2.2 MHz to 6.0 MHz (< 3 GHz CF) ± 0.02 dB nominal

Bandwidth accuracy (–3.01 dB):

RBW range 8 MHz (< 3 GHz CF) ± 15 % nominal

Selectivity (–60 dB/–3 dB)

4.1:1 nominal

EMI Resolution Bandwidths

CISPR family	200 Hz, 9 kHz, 120 kHz, 1 MHz
MIL STD family	10 Hz, 100 Hz, 1 kHz, 10 kHz, 100 kHz, 1 MHz

Analysis Bandwidths

Maximum FFT width	10 MHz
	80 MHz, 14 bit ADC (E444xA-122),
	40 MHz, 14 bit ADC (E444xA-140)

I/Q waveform digital output bandwidth

10 MHz (E444xA-B7J)
 80 MHz, 14 bit ADC (E444xA-122),
 80 MHz, 14 bit ADC (E444xA-140)

321.4 MHz IF output

–1 dB bandwidth

–3 dB bandwidth

70 MHz IF output

(Option E444xA-H70)

–1 dB bandwidth

–3 dB bandwidth

(except E4447A)
 20 to 30 MHz nominal
 30 to 100 MHz nominal

Video Bandwidth (VBW)

Range	1 Hz to 3 MHz (10 % steps), 4, 5, 6, 8 MHz and wide open
Accuracy	± 6 % nominal

Stability

Noise sidebands (20°C to 30°C, CF = 1 GHz)

Offset	Specification	Typical
100 Hz	–91 dBc/Hz	–96 dBc/Hz
1 kHz	–103 dBc/Hz	–108 dBc/Hz
10 kHz	–116 dBc/Hz	–118 dBc/Hz
30 kHz	–116 dBc/Hz	–118 dBc/Hz
100 kHz	–122 dBc/Hz	–124 dBc/Hz
1 MHz	–145 dBc/Hz	–147 dBc/Hz
6 MHz	–154 dBc/Hz	–156 dBc/Hz
10 MHz	–156 dBc/Hz	–157.5 dBc/Hz

Amplitude Specifications**Amplitude Range**

Measurement range	Displayed average noise level (DANL) to maximum safe input level
Input attenuator range	0 to 70 dB in 2 dB steps

Maximum Safe Input Level

Average total power	+30 dBm (1 W)
Preamp	
Option E444xA-1DS	+30 dBm
Option E444xA-110	+25 dBm
Peak pulse power	
<10 μ s pulse width,	
<1 % duty cycle and	
input attenuation \geq 30 dB	+50 dBm (100 W)
DC volts:	
DC coupled	$\leq \pm 0.2$ Vdc
AC coupled	
(E4443A, E4445A, E4440A only)	± 100 Vdc

1 dB Gain Compression (Two-Tone)

	Total Power at Input Mixer
20 MHz to 200 MHz	0 dBm
	+3 dBm nominal
200 MHz to 3 GHz	+3 dBm
	+7 dBm nominal
3 GHz to 6.6 GHz	+3 dBm
	+4 dBm nominal
6.6 GHz to 26.5 GHz	-2 dBm
	0 dBm nominal
26.5 GHz to 50 GHz	0 dBm nominal

Typical Gain Compression (Two-Tone)

	Mixer Level	Typical Compression
20 MHz to 200 MHz	0 dBm	<0.5 dB
200 MHz to 6.6 GHz	+3 dBm	<0.5 dB
6.6 GHz to 26.5 GHz	-2 dBm	<0.4 dB

Preamp Gain Compression (Option E444xA-1 DS)

10 MHz to 200 MHz	-30 dBm nominal
200 MHz to 3 GHz	-25 dBm nominal

Preamp Gain Compression (Option E444xA-110)

10 MHz to 200 MHz	-24 dBm nominal
200 MHz to 3 GHz	-20 dBm nominal
3 to 6.6 GHz	-23 dBm nominal
6.6 to 30 GHz	-27 dBm nominal
30 to 50 GHz	-24 dBm nominal

Displayed Average Noise Level (DANL)

(Input terminated, sample or average detector, averaging type = Log, 20 to 30°C, zero span, swept normalized to 1 Hz RBW, 0 dB attenuation)

	Specification	Typical
E4443A/E4445A/E4440A		
3 Hz to 1 kHz	—	-110 dBm nominal
1 kHz to 10 kHz	—	-130 dBm nominal
10 kHz to 100 kHz	-137 dBm	-141 dBm
100 kHz to 1 MHz	-145 dBm	-149 dBm
1 MHz to 10 MHz	-150 dBm	-153 dBm
10 MHz to 1.2 GHz	-154 dBm	-155 dBm
1.2 GHz to 2.1 GHz	-153 dBm	-154 dBm
2.1 GHz to 3.0 GHz	-152 dBm	-153 dBm
3 GHz to 6.6 GHz	-152 dBm	-153 dBm
6.6 GHz to 13.2 GHz	-150 dBm	-152 dBm
13.2 GHz to 20 GHz	-147 dBm	-149 dBm
20 GHz to 26.5 GHz	-143 dBm	-145 dBm

Preamp On (Option E4443/45/40A-1DS)

100 kHz to 200 kHz	-159 dBm	-162 dBm
200 kHz to 500 kHz	-159 dBm	-162 dBm
500 kHz to 1 MHz	-163 dBm	-165 dBm
1 MHz to 10 MHz	-166 dBm	-168 dBm
10 MHz to 500 MHz	-169 dBm	-170 dBm
500 MHz to 1.1 GHz	-168 dBm	-169 dBm
1.1 GHz to 2.1 GHz	-167 dBm	-168 dBm
2.1 GHz to 3.0 GHz	-165 dBm	-166 dBm

Preamp On (Option E4443/45/40A-110)

10 to 50 MHz	-148 dBm	-154 dBm
50 to 500 MHz	-153 dBm	-164 dBm
500 MHz to 3 GHz	-166 dBm	-168 dBm
3 to 6.6 GHz	-165 dBm	-166 dBm
6.6 to 13.2 GHz	-163 dBm	-165 dBm
13.2 to 16 GHz	-162 dBm	-165 dBm
16 to 19 GHz	-162 dBm	-164 dBm
19 to 26.5 GHz	-159 dBm	-161 dBm

E4447A/E4446A/E4448A

3 Hz to 1 kHz	—	-110 dBm nominal
1 kHz to 10 kHz	—	-130 dBm nominal
10 kHz to 100 kHz	-137 dBm	-141 dBm
100 kHz to 1 MHz	-145 dBm	-150 dBm
1 MHz to 10 MHz	-150 dBm	-155 dBm
10 MHz to 1.2 GHz	-153 dBm	-154 dBm
1.2 GHz to 2.1 GHz	-152 dBm	-153 dBm
2.1 GHz to 3 GHz	-151 dBm	-152 dBm
3 GHz to 6.6 GHz	-151 dBm	-152 dBm
6.6 GHz to 13.2 GHz	-146 dBm	-149 dBm
13.2 GHz to 20 GHz	-144 dBm	-146 dBm
20 GHz to 22.5 GHz	-143 dBm	-146 dBm
22.5 GHz to 26.8 GHz	-140 dBm	-144 dBm
26.8 GHz to 31.15 GHz	-142 dBm	-145 dBm
31.15 GHz to 35 GHz	-134 dBm	-136 dBm
35 GHz to 38 GHz	-129 dBm	-132 dBm
38 GHz to 44 GHz	-131 dBm	-134 dBm
44 GHz to 49 GHz	-128 dBm	-131 dBm
49 GHz to 50 GHz	-127 dBm	-130 dBm

Preamp On (Option E4447/46/48A-1DS)

100 kHz to 200 kHz	-158 dBm	-162 dBm
200 kHz to 500 kHz	-158 dBm	-162 dBm
500 kHz to 10 MHz	-161 dBm	-165 dBm
1 MHz to 10 MHz	-167 dBm	-169 dBm
10 MHz to 500 MHz	-167 dBm	-169 dBm
500 MHz to 1.2 GHz	-166 dBm	-168 dBm
1.2 GHz to 2.1 GHz	-165 dBm	-167 dBm
2.1 GHz to 3.0 GHz	-163 dBm	-165 dBm

Preamp On (Option E4447/46/48A-110)

10 to 50 MHz	-148 dBm	-158 dBm
50 to 500 MHz	-153 dBm	-164 dBm
500 MHz to 2.1 GHz	-165 dBm	-168 dBm
2.1 to 6.6 GHz	-165 dBm	-167 dBm
6.6 to 13.2 GHz	-162 dBm	-165 dBm
13.2 to 19 GHz	-161 dBm	-163 dBm
19 to 22.5 GHz	-161 dBm	-162 dBm
22.5 to 26.8 GHz	-155 dBm	-160 dBm
26.8 to 31.15 GHz	-157 dBm	-161 dBm
31.15 to 35 GHz	-152 dBm	-156 dBm
35 to 44 GHz	-146 dBm	-150 dBm
44 to 45 GHz	-143 dBm	-150 dBm
45 to 49 GHz	-143 dBm	-146 dBm
49 to 50 GHz	-140 dBm	-145 dBm

E4443A
E4445A
E4440A
E4447A
E4446A
E4448A

E4443A
E4445A
E4440A
E4447A
E4446A
E4448A

Display Range

Log scale	0.1 to 1 dB/division in 0.1 dB steps 1 to 20 dB/division in 1 dB steps (10 display divisions)
Linear scale	10 divisions
Scale units	dBm, dBmV, dBuV, V, and W

Frequency Response

(10 dB input attenuation, 20 to 30°C, preselector centering applied)

E4443A/E4445A/E4440A		Typical
3 Hz to 3 GHz	±0.38 dB	±0.11 dB
3 GHz to 6.6 GHz	±1.50 dB	±0.6 dB
6.6 GHz to 22 GHz	±2.00 dB	±1.0 dB
22 GHz to 26.5 GHz	±2.50 dB	±1.3 dB
E4447A/E4446A/E4448A		
3 Hz to 3 GHz	±0.38 dB	±0.15 dB
3 GHz to 6.6 GHz	±1.50 dB	±0.6 dB
6.6 GHz to 22 GHz	±2.00 dB	±1.2 dB
22 GHz to 26.8 GHz	±2.50 dB	±1.3 dB
26.4 GHz to 31.15 GHz	±1.75 dB	±0.6 dB
31.15 GHz to 50 GHz	±2.50 dB	±1.0 dB

Frequency Response at Attenuation ≠ 10 dB

(Atten = 20, 30, or 40 dB)

10 MHz to 2.2 GHz	±0.53 dB
2.2 GHz to 3 GHz	±0.69 dB

Preamp On (Option E444xA-1DS), (for all models)

100 kHz to 3 GHz	±0.70 dB	<(±0.30 dB typical)
Preamp On (Option E4443/45/40A-110, 0 dB input attenuation)		
10 MHz to 3.0 GHz	±1.0 dB	(±0.35 dB typical)
3.0 to 6.6 GHz	±1.75 dB	(±0.8 dB typical)
6.6 to 13.2 GHz	±3.0 dB	(±1.0 dB typical)
13.2 to 19 GHz	±3.0 dB	(±1.2 dB typical)
19 to 26.5 GHz	±4.0 dB	(±2.0 dB typical)

Preamp On (Option E4447/46/48A-110, 0 dB input attenuation)

10 MHz to 3.0 GHz	±1.3 dB	(±0.5 dB typical)
3.0 to 6.6 GHz	±2.5 dB	(±1.0 dB typical)
6.6 to 13.2 GHz	±2.5 dB	(±1.2 dB typical)
13.2 to 19 GHz	±3.0 dB	(±1.5 dB typical)
19 to 26.5 GHz	±4.0 dB	(±2.0 dB typical)
26.5 to 31.15 GHz	±3.0 dB	(±1.2 dB typical)
31.15 to 50 GHz	±3.5 dB	(±1.6 dB typical)

Input Attenuation Switching Uncertainty

(Attenuator setting ≥2 dB)

At 50 MHz	±0.18 dB (±0.053 dB typical)
3 Hz to 3 GHz	±0.3 dB nominal
3 GHz to 13.2 GHz	±0.5 dB nominal
13.2 GHz to 26.5 GHz	±0.6 dB nominal
26.5 GHz to 50 GHz	±1.0 dB nominal

Absolute Amplitude Accuracy

(10 dB input attenuation, 20 to 30°C, 10 Hz ≤ RBW ≤ 1 MHz, input signal -10 to -50 dBm, all settings auto-coupled except Auto Swp Time = Accy, any reference level, any scale)

At 50 MHz	±0.24 dB (±0.06 dB typical)
At all frequencies	±(0.24 dB + frequency response)
	±(0.06 dB + frequency response) typical
3 Hz to 3 GHz (95% confidence)	±0.19 dB
Preamp on (Option E444xA-1DS)	±(0.36 dB + frequency response)
	±(0.09 dB + frequency response) typical
Preamp on (Option E444xA-110)	±(0.40 dB + frequency response)
	±(0.15 dB + frequency response) typical

Input Voltage Standing Wave Ratio (VSWR)

(≥8 dB input attenuation)

50 MHz to 3 GHz	<1.2:1 nominal
3 GHz to 18 GHz	<1.6:1 nominal
18 GHz to 26.5 GHz	<1.9:1 nominal
26.5 GHz to 50 GHz	<1.6:1 nominal
Preamp on (50 MHz to 3 GHz)	
(≥10 dB attenuation)	<1.2:1 nominal

Resolution Bandwidth Switching Uncertainty

(referenced to 30 kHz RBW)

1 Hz to 1 MHz RBW	±0.03 dB
1.1 MHz to 3 MHz RBW	±0.05 dB
4, 5, 6, 8 MHz RBW	±1.0 dB

Reference Level

Range:

Log scale	-170 dBm to +30 dBm in 0.01 dB steps
Linear scale	707 pV to 7.07 V in 0.1 % steps
Accuracy	0 dB

Display Scale Switching Uncertainty

Switching between linear and log	0 dB
Log scale/div switching	0 dB

Display Scale Fidelity

≤-20 dBm input mixer level	±0.07 dB total
-20 dBm < mixer level ≤ -10 dBm	±0.13 dB total

Spurious Response (mixer level = -40 dBm)

General spurious:

f < 10 MHz from carrier	(-73 + 20 log N) dBc
f ≥ 10 MHz from carrier	(-80 + 20 log N) dBc
	(-90 + 20 log N) dBc typical

See frequency range for N

Second Harmonic Distortion (SHI)

E4443A, E4445A, E4440A	Distortion (dBc)	SHI (dBm)
10 MHz to 460 MHz	-82	+42
(-40 dBm mixer level)		
460 MHz to 1.18 GHz	-92	+52
(-40 dBm mixer level)		
1.18 GHz to 1.5 GHz	-82	+42
(-40 dBm mixer level)		
1.5 GHz to 2.0 GHz	-90	+80
(-10 dBm mixer level)		
2.0 GHz to 13.25 GHz	-100	+90
(-10 dBm mixer level)		
E4447A, E4446A, E4448A	Distortion (dBc)	SHI (dBm)
10 MHz to 460 MHz	-82	+42
(-40 dBm mixer level)		
460 MHz to 1.18 GHz	-92	+51
(-40 dBm mixer level)		
1.18 GHz to 1.5 GHz	-82	+41
(-40 dBm mixer level)		
1.5 GHz to 2.0 GHz	-90	+80
(-10 dBm mixer level)		
2.0 GHz to 3.25 GHz	-94	+84
(-10 dBm mixer level)		
3.25 GHz to 13.25 GHz	-96	+86
(-10 dBm mixer level)		
13.25 GHz to 25 GHz	-100 nominal	+90 nominal
(-10 dBm mixer level)		

Preamp On (Option E444xA-1DS, for all models, input preamp level = -45 dBm)

10 MHz to 1.5 GHz	-60 nominal	+15 nominal
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Preamp On (Option E444xA-110, input preamp level = -45 dBm)

10 MHz to 25 GHz	-45 nominal	+10 nominal
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Third-Order Intermodulation Distortion (TOI)

(two -30 dBm tones at input mixer with tone separation >15 kHz, 20 to 30°C)

E4443A/E4445A/E4440A	Distortion (dBc)	TOI (dBm)
10 MHz to 100 MHz	-88	+14 (+17 typical)
100 MHz to 400 MHz	-90	+15 (+18 typical)
400 MHz to 1.7 GHz	-92	+16 (+19 typical)
1.7 GHz to 2.7 GHz	-94	+17 (+19 typical)
2.7 GHz to 3.0 GHz	-94	+17 (+20 typical)
3.0 GHz to 6.0 GHz	-90	+15 (+18 typical)
6.0 GHz to 16 GHz	-76	+8 (+11 typical)
16 GHz to 26.5 GHz	-84	+12 (+14 typical)
E4447A/E4446A/E4448A	Distortion (dBc)	TOI (dBm)
10 MHz to 100 MHz	-90	+15 (+20 typical)
100 MHz to 400 MHz	-92	+16 (+21 typical)
400 MHz to 1.7 GHz	-94	+17 (+20 typical)
1.7 GHz to 2.7 GHz	-96	+18 (+21 typical)
2.7 GHz to 3.0 GHz	-96	+18 (+21 typical)
3.0 GHz to 6.0 GHz	-92	+16 (+21 typical)
6.0 GHz to 16.0 GHz	-84	+12 (+15 typical)
16.0 GHz to 26.5 GHz	-84	+12 (+15 typical)
26.5 GHz to 50.0 GHz	-85	+12.5 nominal

Preamp on (Option E444xA-1DS, for all models, two -45 dBm tones at preamp input)

10 MHz to 500 MHz	-15 nominal
500 MHz to 3 GHz	-13 nominal

Preamp on (Option E444xA-110, two -45 dBm tones at preamp input)

10 MHz to 3.0 GHz	-15 dB nominal
3.0 to 6.6 GHz	-21 dB nominal
6.6 to 13.2 GHz	-23 dB nominal
13.2 to 19 GHz	-23 dB nominal
19 to 26.5 GHz	-25 dB nominal

Residual Responses

Input terminated and 0 dB attenuation

200 kHz to 6.6 GHz	-100 dBm
6.6 GHz to 26.8 GHz	-100 dBm nominal
26.8 GHz to 50 GHz	-90 dBm nominal

Trace Detectors

Normal, peak, sample, negative peak, log power average, RMS average, voltage average, quasi-peak, EMI average, MIL-peak and EMI peak

Option E444xA-1DS, Preamplifier

Frequency range	100 kHz to 3 GHz
Gain	28 dB nominal
Noise figure	7 dB nominal

Option E444xA-110, Preamplifier

Frequency range	10 MHz to 50 GHz	
Gain	10 MHz to 30 GHz	27 dB (nominal)
	30 to 50 GHz	24 dB (nominal)
Noise figure	10 to 30 MHz	12.5 dB (nominal)
	30 MHz to 3 GHz	7.8 dB (nominal)
	3 to 30 GHz	10.3 dB (nominal)
	30 to 50 GHz	21.8 dB (nominal)

Option E444xA-123, Switchable MW Preselector Bypass

DANL	-153 dB typical
Frequency response	±0.2 dB typical

Measurement Speed

Local measurement and display update rate	≥50/s nominal
Remote measurement and GPIB transfer rate	
101 sweep points	≥45/s nominal
401 sweep points	≥30/s nominal
601 sweep points	≥25/s nominal

Power Suite Measurement Specifications**Channel Power**

Amplitude accuracy, W-CDMA or IS95
(20 to 30 °C, mixer level <-20 dBm) ±0.68 dB (±0.18 dB typical)

Occupied Bandwidth

Frequency accuracy ± [span/600] nominal

Adjacent Channel Power

Accuracy, W-CDMA (ACLR) (at specific mixer levels and ACLR ranges):

	Adjacent	Alternate
MS	±0.12 dB	±0.17 dB
BTS	±0.22 dB	±0.22 dB

Dynamic range (typical):

w/o noise correction	-74.5 dB	-82 dB
w/noise correction	-81 dB	-88 dB

Offset channel pairs measured

1 to 6

Multi-Carrier Power and ACP

Fast ACP speed <30 ms (std dev 0.2 dB, nominal)

ACPR dynamic range, W-CDMA (5 MHz offset, RRC weighted, 3.84 MHz noise bandwidth):

Two carriers	-70 dB nominal
Four carriers	-68 dB nominal

ACPR accuracy

(two carriers, 5 MHz offset, -48 dBc ACPR) ±0.38 dB nominal

Multiple number of carriers measured

Up to 12

Power Statistics CCDF

Histogram resolution 0.1 dB

Harmonic Distortion

Maximum harmonic number 10th
Results Fundamental power (dBm), relative harmonics power (dBc), total harmonic distortion in percent

Intermod (TOI)

Measure the third-order products and intercepts from two tones

Burst Power

Methods	Power above threshold, power within burst width
Results	Output power, average output power, single burst maximum power, minimum power within burst, burst width

Spurious Emission

cdma2000 or W-CDMA (1980 MHz region, 1.2 MHz RBW)

Table driven spurious signals; search across regions.

Relative dynamic range 80.6 dB (82.4 dB typical)

Absolute sensitivity -89.7 dBm (-91.7 dBm typical)

Spectrum Emission Mask (SEM)

cdma2000 (750 kHz offset):

Relative dynamic range (30 kHz RBW)	85.3 dB (88.3 dB typical)
Absolute sensitivity	-105.7 dBm (-107 dBm typical)
Relative accuracy	±0.09 dB
3GPP W-CDMA (2.515 MHz offset):	
Relative dynamic range (30 kHz RBW)	87.3 dB (89.5 dB typical)
Absolute sensitivity	-105.7 dBm (-107.7 dBm typical)
Relative accuracy	±0.10 dB

E4443A
E4445A
E4440A
E4447A
E4446A
E4448A

E4443A
E4445A
E4440A
E4447A
E4446A
E4448A

General Specifications**Temperature Range**

Operating	0°C to +55°C
Storage	–40°C to +75°C

EMI Compatibility

Radiated and conducted emission is in compliance with CISPR Pub.11/1996 Class A and B
Complies with radiated electromagnetic field immunity requirement in IEC/EN 61326 using performance criterion B

Audio Noise

ISO 7779	LNPE <5.0 BELS at 25°C
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Military Specification

Type tested to environmental specifications MIL-PRF-28800F Class 3

Power Requirements

Voltage and frequency:

100 to 132 V_{rms}, 47 to 66 Hz/360 to 440 Hz

195 to 250 V_{rms}, 47 to 66 Hz

Power consumption:

On	<260 watts, no options (<450 watts, all options)
Standby	<20 watts

Weight (without options)

E4443A, E4445A, E4440A

Net	23 kg (50 lbs) nominal
Shipping	33 kg (73 lbs) nominal

E4447A, E4446A, E4448A

Net	24 kg (53 lbs) nominal
Shipping	34 kg (76 lbs) nominal

Dimensions

Height	177 mm (7.0 in)
Width	426 mm (16.8 in)
Length	483 mm (19 in)

Warranty

The E4440A, E4443A, E4445A, E4446A, E4447A and E4448A are supplied with a one-year standard warranty.

Calibration Cycle

The recommended calibration cycle is one year. Calibration services are available through Agilent service centers.

Input and Outputs**Front Panel****RF Input**

Connector:	
E4443A/E4445A	Type-N female, 50 Ω
E4440A	Type-N female, 50 Ω
E4440A-BAB	APC 3.5 male
E4447A/E4446A/E4448A	2.4 mm male, 50 Ω

Probe Power

Voltage/current (nominal)	+15 Vdc, ±7 % at 150 mA max –12.6 Vdc, ±10 % at 150 mA max GND
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Ext Trigger Input

Connector	BNC female
Impedance	10 kΩ nominal
Trigger level	5 V TTL nominal

Option AYZ External Mixing**IF Input**

Connector	SMA, female
Center frequency	321.4 MHz
3 dB bandwidth	60 MHz nominal
Maximum safe input level	+10 dBm
Absolute amplitude accuracy	±1.2 dB

Mixer Bias Current

Range	±10 mA
Output impedance	77 Ω nominal
Mixer bias voltage	±3.7 V (measured in an open circuit)

LO Output

Connector	SMA, female
Impedance	50 Ω nominal
Frequency range	3.05 to 6.89 GHz
VSWR	<2.0:1 (nominal)

LO Power Out

E4440A	+13.5 to +18.5 dBm
E4447A, E4446A, E4448A	+14.5 to +18.8 dBm

Rear Panel**10 MHz OUT (switched)**

Connector	BNC female, 50 Ω
Output amplitude	≥0 dBm nominal
Frequency accuracy	10 MHz ±(10 MHz x frequency reference accuracy)

Ext Ref In

Connector	BNC female, 50 Ω
Input amplitude range	–5 to +10 dBm nominal
Input frequency	1 to 30 MHz nominal
Frequency lock range	±5 x 10 ⁻⁶ of specified external reference input frequency

Trigger In

Connector	BNC female
External trigger input:	
Impedance	>10 kΩ nominal
Trigger level	5 V TTL

Trigger 1 and Trigger 2 Outputs

Connector	BNC female
Trigger 1 output:	HSWP (high = sweeping)
Impedance	50 Ω nominal
Level	5 V TTL
Trigger 2 output	Reserved for future applications

Monitor Output

Connector	VGA compatible, 15-pin mini D-SUB
Format	VGA (31.5 kHz horizontal, 60 Hz vertical sync rates, non-interlaced) Analog RGB 640 X 480

Resolution

Noise Source Drive Output

Connector	BNC female
Output voltage	
On	28.0 ±0.1 V (60 mA maximum)
Off	<1 V

Remote Programming

GPIO interface:	
Connector	IEEE-488 bus connector
GPIO codes	SH1, AH1, T6, SR1, RL1, PP0, DC1, C1, C2, C3, and C28, DT1, L4, C0
Serial interface connector	9-pin D-SUB male (factory use only)
LAN TCP/IP interface	RJ45 Ethernet
USB interface	USB 2.0 device side I/O interface

Parallel Printer Interface Connector

25-pin D-SUB female

321.4 MHz IF Output (except E4447A)

Connector	SMA female, 50 Ω nominal
Frequency	321.4 MHz nominal
Conversion gain	+2 to +4 dB nominal

Key Literature & Web Link

Select the Right Signal Analyzer for Your Needs Selection Guide, p/n 5968-3413E
 PSA Series Brochure, p/n 5980-1283E
 PSA Series Data Sheet, p/n 5980-1284E
 PSA Series Configuration Guide, p/n 5989-2773EN
 Self-Guided Demonstration for Spectrum Analysis Product Note, p/n 5988-0735EN
 Phase Noise Measurement Personality Technical Overview, p/n 5988-3698EN
 Noise Figure Measurement Personality Technical Overview, p/n 5988-7884EN
 External Source Control Measurement Personality Technical Overview, p/n 5989-2240EN
 Flexible Digital Modulation Analysis Measurement Personality Technical Overview, p/n 5989-1119EN
 W-CDMA and HSDPA Measurement Personalities Technical Overview, p/n 5988-2388EN
 GSM with EDGE Measurement Personality Technical Overview, p/n 5988-2389EN
 cdma2000 and 1xEV-DV Measurement Personalities Technical Overview, p/n 5988-3694EN
 1xEV-DO Measurement Personality Technical Overview, p/n 5988-4828EN
 cdmaOne Measurement Personality Technical Overview, p/n 5988-3695EN
 WLAN Measurement Personality Technical Overview, p/n 5989-2781EN
 NADC/PDC Measurement Personality Technical Overview, p/n 5988-3697EN
 TD-SCDMA Measurement Personality Technical Overview, p/n 5989-0056EN
 Built-in Measuring Receiver Personality/Agilent N5531S Measuring Receiver Technical Overview, p/n 5989-4795EN
 BenchLink Web Remote Control Software Product Overview, p/n 5988-2610EN
 IntuiLink Software Data Sheet, p/n 5980-3115EN
 Programming Code Compatibility Suite Technical Overview, p/n 5989-1111EN
 40/80 MHz Bandwidth Digitizers Technical Overview, p/n 5989-1115EN
 Vector Signal Analysis Basics Application Note 150-15, p/n 5989-1121EN
 using Extended Calibration Software for Wide Bandwidth Measurements, PSA Option 122 & 89600 VSA Application Note 1443, p/n 5988-7814EN
 PSA Series Spectrum Analyzer Performance Guide using 89601A Vector Signal Analysis Software Product Note, p/n 5988-5015EN
 89650S Wideband VSA System with High Performance Spectrum Analysis Technical Overview, p/n 5989-0671E
 PSA Series Spectrum Analyzer Video Output (Option 124) Technical Overview, p/n 5989-1118EN
 PSA Series Spectrum Analyzers, Option H70, 70 MHz IF Output Product Overview, p/n 5986-5261EN
 8 Hints for Millimeter Wave Spectrum Measurement Application Note, p/n 5988-5680EN
 Spectrum Analyzer Basics Application Note 150, p/n 5952-0292
 Making Precompliance Conducted and Radiated Emissions Measurements with the PSA, (AN 150-10) Application Note 150-10, p/n 5989-1550EN
 External Waveguide Mixing and Millimeter Wave Measurements with Agilent PSA Spectrum Analyzers Application Note 1485, p/n 5988-9414EN
 Agilent PSA series Optimizing Dynamic Range Product Note, p/n 5980-3079EN
 PSA Series Amplitude Accuracy Product Note, p/n 5980-3080EN
 Performance Spectrum Analyzer Series Swept and FFT Analysis Application Note, p/n 5980-3081EN
 PSA Series Measurement Innovations and Benefits Product Note, p/n 5980-3082EN
 For more information on the PSA Series, please visit:
www.agilent.com/find/psa

Ordering Information

PSA Series Spectrum Analyzer

E4443A 3 Hz to 6.7 GHz
E4445A 3 Hz to 13.2 GHz
E4440A 3 Hz to 26.5 GHz
E4447A 3 Hz to 42.98 GHz
E4446A 3 Hz to 44 GHz
E4448A 3 Hz to 50 GHz

Options

To Add Options to a Product, Use the Following Ordering Scheme:
 Model: E444xA (x = 0, 3, 5, 6, 7 or 8)

Example Options: E4440A-B7J, E4448A-1DS

Digital Demodulation Hardware

E444xA-B7J: Digital Demodulation Hardware (required for digital demodulation measurement personalities)

Digital Wireless Communication Measurements

E444xA-BAF W-CDMA Measurement Personality
E444xA-210 HSDPA/HSUPA Measurement Personality
E444xA-202 GSM w/EDGE Measurement Personality
E444xA-B78 cdma2000 Measurement Personality
E444xA-204 1xEV-DO Measurement Personality
E444xA-214 1xEV-DV Measurement Personality
E444xA-BAC cdmaOne Measurement Personality
E444xA-BAE NADC, PDC Measurement Personality
E444xA-241 Flexible Digital Modulation Analysis Personality
E444xA-211 TD-SCDMA Power Measurement Personality
E444xA-212 TD-SCDMA Modulation Analysis Measurement Personality
E444xA-213 HSDPA/8PSK for TD-SCMA Analysis (requires option 212)
E444xA-217 WLAN Measurement Personality (requires option 122 or 140)

Other Measurements and Controls

E444xA-226 Phase Noise Measurement Personality
E444xA-219 Noise Figure Measurement Personality
E444xA-215 External Source Control Measurement Personality
E444xA-233 Built-in Measuring Receiver Personality
E444xA-23A AM/FM/PM Triggering for Measuring Receiver (requires option 233)
E444xA-23B CCITT Filter for Audio Measurements (requires options 233/107)
E444xA-117 Secure Memory Erase
E444xA-239 N9039A RF Preselector Control

Hardware Options

E444xA-AYZ External Mixing
E444xA-122 80 MHz Bandwidth Digitizer (E4443A, E4445A, E4440A only)
E444xA-140 40 MHz Bandwidth Digitizer (E4443A, E4445A, E4440A only)
E444xA-1DS 100 kHz to 3 GHz Built-in Preamplifier
E444xA-110 Built-in Preamp Covering 10 MHz to Max Frequency of PSA
E4440A-107 Audio Input 100 kohm (requires option 233)

Inputs and Outputs

E4440A-BAB Replaces Type "N" Input Connector with APC 3.5 Connector

Connectivity Software

E444xA-230 BenchLink Web Remote Control Software

Code Compatibility

E444xA-266 HP 8566B/8568B Code Compatibility Measurement Personality

Accessories

E444xA-1CM Rackmount Kit
E444xA-1CN Front Handle Kit
E444xA-1CP Rackmount with Handles
E444xA-1CR Rack Slide Kit
E444xA-045 Millimeter Wave Accessory Kit
E444xA-0B1 Extra Manual Set Including CD ROM

Warranty and Service

Standard warranty is 1 year

R-51B-001-3C 1 Year Return-to-Agilent warranty extended to 3 years

Calibration¹

R-50C-001 Standard Calibration
R-50C-002 Standards Compliant Calibration
E444xA-0BW Service Manual, Assembly Level
E444xA-UK6 Commercial Calibration Certificate with Test Data
R-52A Calibration Software and Licensing (ordered with PSA)
N7810A PSA Calibration and Licensing (ordered stand-alone)

¹ Options not available in all countries

E4443A
 E4445A
 E4440A
 E4447A
 E4446A
 E4448A

N5531S
N5532A

- **Absolute RF power:** Accuracy of a modern digital power meter combined with a specially designed sensor module using 848x thermal-couple power sensor
- **Tuned RF level (TRFL):** measurement sensitivity of as low as -140 dBm¹ with level accuracy exceeding source/attenuator calibration requirements
- **Frequency counter:** 0.001 Hz frequency resolution and up to -100 dBm sensitivity (manual mode)
- **Analog modulation analysis:** AM, FM, and Φ M to verify correct source modulation index and distortion
- **Optional audio analysis capabilities** with high-impedance audio input
- **N5532A sensor modules** with single input connection up to 50 GHz for accuracy, productivity, and repeatability
- **Remote control** through SCPI commands



N5531S Measuring Receiver

The Agilent N5531S measuring receiver is comprised of a PSA high-performance spectrum analyzer with Option 233 (Built-in measuring receiver personality), a P-series precision power meter (N1911A/12A), and an N5532A sensor module. It combines multiple precision measurement functions into one compact, integrated system that set the new standards for metrology grade of RF, microwave, and millimeter-wave signal measurement up to 50 GHz. The available key measurements include: frequency counter, absolute RF power, TRFL, AM depth, FM deviation, Φ M deviation, modulation rate, and modulation distortion. Additionally, audio measurements are also available (with Option 107 being installed to the PSA), which include audio frequency counter, audio level, and audio distortion/SINAD measurements.

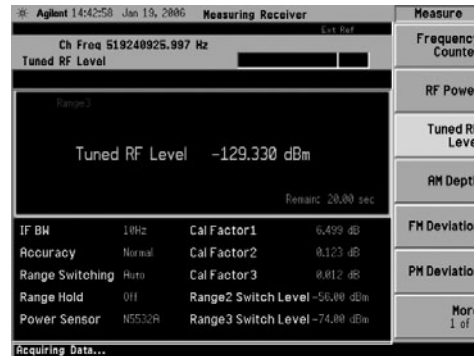
Metrology and Calibration Applications

The N5531S is a successor to the legacy 8902A measuring receiver and extends the frequency coverage to 50 GHz. The N5531S offers superior accuracy, exceedingly wide dynamic range, repeatability, and traceability mandated by metrology and calibration labs. By placing the receiver measurements and controls directly into the PSA, the need for an external computer is eliminated – providing a more compact measuring receiver system.

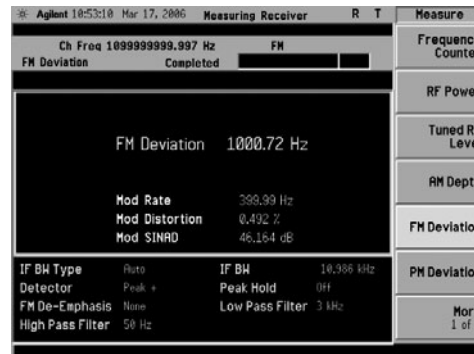
The built-in measuring receiver personality (Option 233) installed in the PSA enables users to set the measurement parameters and to initiate the measurement via the PSA's front panel. One button pressing can switch between the measuring receiver mode to other modes, such as spectrum analysis, easily and quickly. Measurement results are shown on the PSA's display.

Combining with P-Series power meter's accuracy and the PSA's outstanding linearity, the N5531S provides superior absolute RF amplitude specifications to meet or exceed the most challenging requirements for calibrating the signal sources. The excellent sensitivity of the N5531S in tuned RF level (TRFL) measurements allows the users to calibrate step attenuators with the widest dynamic range within the demanded measurement uncertainty and speed.

As the input signal level to the measurement receiver decreases, the signal-to-noise ratio (SNR) will have increasingly significant contribution to the measurement uncertainty. Taking the SNR into account, the N5531S provides comprehensive TRFL level accuracy specifications across the entire measurement range, which offers realistic confidence for your measurement results.



The N5531S offers superb analog modulation analysis capabilities that enable the users to quantify their signal sources' modulation accuracy at the metrology-grade level for the carrier signal frequency as high as 50 GHz. The measurement parameters, such as filter bandwidth and the number of averages, can be manually set by pressing the PSA front panel keys to optimize the modulation analysis. Different speed settings also allow the users for the best compromise between the measurement speed and accuracy.



The optional audio analysis capability of the N5531S (PSA Option 107), based on the latest digital signal processing technologies, provides ideal tool to characterize audio signals. A large set of preconditioning filters, including the CCITT filter (PSA Option 23B), helps users to achieve the best possible audio analysis and to measure their audio signals against the regulations.

¹ Refer to the PSA Measuring Receiver Personality Specifications Guide (Literature Number: E4440-90333) for more details.

Signal Characterization

The N5531S is also an excellent research and development lab tool for accurately characterizing signals from 100 kHz to 50 GHz. Level measurements down to -140 dBm with superb accuracy and linearity makes the N5531S ideal for testing various RF, microwave, and millimeter devices.

As the N5531S measuring receiver consists of a PSA high-performance spectrum analyzer and a P-Series power meter, its users can gain full benefits from the stand-alone instruments. With other optional measurement personalities, the PSA can help you to analyze complex digitally modulated signals used in the modern wireless communications, such as W-CDMA, HSDPA/HSUPA, cdma2000, TD-SCDMA, and GSM/EDGE, or to conduct one-button tests for phase noise and noise figure.



N5532A Sensor Modules with Single Input Connection

Four types of sensor modules were designed specifically for use with the N5531S measuring receiver to cover different frequency bands: N5532A-504 (100 kHz to 4.2 GHz), N5532A-518 (10 MHz to 18 GHz), N5532A-526 (30 MHz to 26.5 GHz), and N5532A-550 (30 MHz to 50 GHz). With these sensor modules, you can characterize the absolute amplitudes of a signal without switching back and forth between the power meter and PSA's RF input, which helps to ensure your measurement integrity. While the N5532A sensor module have exactly same form factor as those used for the 8902A (11722A or 11792A), they have been mechanically and electronically improved for better reliability, sensibility, and repeatability.

Each N5532A sensor module is shipped with its specific calibration factor data file that will be loaded and saved to the PSA to ensure the highest possible measurement accuracy.

N5531S Key Specifications¹

RF Power (with power meter and N5532A sensor module)

- Range: +30 dBm (1 W) to -10 dBm (100 μ W)
- Frequency: 100 kHz to 50 GHz
- Linearity: ± 0.02 dB
- Input SWR:
 - <1.10:1 (100 kHz to 2 GHz)
 - <1.28:1 (2 to 18 GHz)
 - <1.40:1 (18 to 26.5 GHz)
 - <1.55:1 (26.5 to 33 GHz)
 - <1.70:1 (33 to 40 GHz)
 - <1.75:1 (40 to 50 GHz)

Tuned RF Level

- Maximum measurable level: +30 dBm
- Minimum measurable level: to -140 dBm (at defaulted 10 Hz RBW with preamp options 1DS or 110, depending on the frequency band)
- Frequency range: 100 kHz to 50 GHz
- Linearity: $\pm(0.009$ dB + 0.005 dB/10 dB step)
- Relative measurement accuracy:
 - $\pm(0.015$ dB + 0.005 dB/10 dB step) (nominal) between the residual noise threshold² to the maximum measurable level
 - Range change uncertainty: ± 0.031 dB

RF Frequency

- Range: 100 kHz to 50 GHz
- Maximum resolution: 0.001 Hz

Amplitude Modulation

- Rates: 20 Hz to 100 kHz
- Depth: 5 to 99%
- Accuracy: $\pm 0.5\%$ of reading, for 10 MHz to 3 GHz frequency range, 50 Hz to 100 kHz rates, and 20 to 99% depth

Frequency Modulation

- Rates: 20 Hz to 200 kHz
- Maximum peak deviation: 400 kHz
- Accuracy: $\pm 1.5\%$ of reading, for 10 MHz to 6.6 GHz frequency range, 50 Hz to 200 kHz rates, 250 to 400 kHz peak deviation, and $\beta^3 > 0.2$

Phase Modulation

- Rates: 200 Hz to 20 kHz
- Maximum peak deviation: 12,499 radians, in "Auto" mode for carrier frequency ≥ 10 MHz
- Accuracy: $\pm 1\%$ of reading, for 100 kHz to 6.6 GHz frequency range, and phase deviations > 0.7 radians

Audio Measurements

- Audio level accuracy: 1% of reading, 100 mV to 3 V (rms)
- Audio frequency range: 20 Hz to 250 kHz
- Audio frequency display resolution: 0.01 Hz (8 digits)
- Audio distortion accuracy: ± 1 dB of reading, 20 Hz to 250 kHz

Ordering Information

PSA Series Spectrum Analyzer (select one)

- E4443A** 3 Hz to 6.7 GHz
- E4445A** 3 Hz to 13.2 GHz
- E4440A** 3 Hz to 26.5 GHz
- E4447A** 3 Hz to 42.98 GHz
- E4446A** 3 Hz to 44 GHz
- E4448A** 3 Hz to 50 GHz

PSA Options (x=0, 3, 5, 6, 7, or 8)

- E444xA-233** Built-in Measuring Receiver Personality
- E444xA-123** μ W Preselector Bypass
(Required for TRFL measurements above 3 GHz)
- E444xA-1DS** RF Internal Preamplifier (Required for the higher sensitivity TRFL measurement below 3 GHz, mutually exclusive with Option 110)
- E444xA-110** RF/ μ W Internal Preamplifier
(Required for the higher sensitivity TRFL measurement from 10 MHz up to the maximum frequency of the PSA, mutually exclusive with Option 1DS)
- E444xA-107** Audio Input 100 kohm (Required for audio analysis)
- E444xA-23A** AM/FM/PM Triggering for Measuring Receiver
(Requires Option 233 to operate)
- E444xA-23B** CCITT Filter for Audio Measurements
(Requires Options 233 and 107 to operate)

P-Series Power Meter (select one)

- N1911A** P-Series Single Channel Power Meter
- N1912A** P-Series Dual Channel Power Meter

N5532A Sensor Modules

- N5532A-504** 100 kHz to 4.2 GHz, type N(m) Input Connector
- N5532A-518** 10 MHz to 18 GHz, type N(m) Input Connector
- N5532A-526** 30 MHz to 26.5 GHz, APC 3.5 mm (m) Input Connector
- N5532A-550** 30 MHz to 50 GHz, 2.4 mm (m) Input Connector
- N5532A-019** Adaptor to N191xA Power Meter
(Required when the N191xA power meter is used)

For more information on the N5531S, please visit:

www.agilent.com/find/N5531S

¹ Refer to the PSA Measuring Receiver Personality Specifications Guide (Literature Number: E4440-90333) for more details.

² The "residual noise threshold" is at 30 dB above the minimum measurable level.

³ β is the ratio of frequency deviation to modulation rate (deviation/rate).

- Continuous 30 Hz to 2.9, 13.2, 26.5, 40, or 50 GHz sweeps
- Resolution bandwidths of 1 Hz to 100 Hz digitally implemented for measurement speed
- Best-in-class performance in phase noise and dynamic range
- Precision timebase and 1 Hz counter resolution
- Adjacent channel power, channel power, carrier power and gated video measurements standard
- Class 3 MIL-rugged
- Color screen
- VGA output



8560EC

8560EC Series Spectrum Analyzers

The 8560EC series portable spectrum analyzers offer the measurement capabilities and performance traditionally found only in larger, more expensive benchtop analyzers. These spectrum analyzers combine outstanding phase noise, sensitivity, 1 Hz resolution bandwidths and wide dynamic range in a Class 3 MIL-rugged package built to withstand harsh environmental conditions.

Capabilities for RF Communications

The ability to measure adjacent channel power (ACP) on wireless telephones, pagers and other transmitters is critical in both R&D and manufacturing. The 8560EC series spectrum analyzers offer a complete solution for ACP testing of burst carrier signals using digital modulation such as is used in NADC-TDMA, GSM, DECT, CT2-CAI, PDC and PHS systems. Many of the implementation difficulties of the established standards have been addressed, providing fast, accurate and easy-to-use ACP measurement capability. Measure W-CDMA adjacent channel power ratio (ACPR) with a dynamic range of at least 70 dB using the 8563E-K35 ACPR test set.

Another standard feature is the ability to measure from 0.10 to 99.99 percent occupied bandwidth.

Additionally, the carrier power and channel power measurements for both continuous and burst signals are also available as the standard features of the 8560EC Series spectrum analyzers.

Time-gated signal analysis is another standard feature that allows you to easily measure time-varying signals such as pulsed RF, time-division multiple access (TDMA), interleaved and burst-modulated. The 85902A burst carrier trigger can supply a TTL trigger signal.

8560EC series specifications have been enhanced. Now, you can get better phase noise, sensitivity, dynamic range and frequency response from this midrange performance portable spectrum analyzer family.

The 8562EC spectrum analyzer provides a 13.2 GHz frequency range with increased dynamic range and third-order intercept (TOI) capability. This allows wireless communications engineers to test high-performance components in burst operation systems.

With the 85672A spurious response measurements utility, you can use 8560EC series spectrum analyzers to make fast and easy spurious response tests.

For more information on RF communications measurement capabilities, refer to page 114.

Fast Digital Resolution Bandwidths

Digitally-implemented resolution bandwidths of 1, 3, 10, 30 and 100 Hz allow the 8560EC series spectrum analyzers to sweep from 3 to 600 times faster than is possible with comparable analog filters. A narrow 5:1 shape factor allows you to view close-in, low-level signals easily. Digital bandwidths also provide the spectrum analyzer with a full 100 dB on-screen calibrated display.

PC Software for 8560EC Series

The Agilent BenchLink Spectrum Analyzer PC software provides an easy-to-use communications link between your PC and the 8560EC series spectrum analyzers. Taking full advantage of the Windows interface, you can easily transfer screen images or trace data via the GPIB interface, thereby making it easy to capture, analyze and document measurement results in your PC. Order Option B70 or E4444A for this PC software.

Precision Frequency and Amplitude

Measure frequencies accurately using the built-in frequency counter. A standard precision frequency reference, with an aging rate of 1×10^{-7} per year, and 1 Hz counter resolution provide confidence in measurement accuracy. At 1 GHz, frequency accuracy of ± 135 Hz after a 15-minute warmup is achieved.

Amplitude measurement uncertainty can be reduced using the amplitude correction (AMPCOR) feature. AMPCOR allows you to enter up to 200 amplitude correction points to compensate for sources of amplitude uncertainty, such as cable losses, preamplifier gain and spectrum analyzer frequency response. After developing a table of correction data, amplitudes that have been referenced to a power meter can be read directly on the spectrum analyzer display.

Digitized, Fast Time-Domain Sweeps

Digitized fast time-domain (zero span) sweeps use markers, trace math, trace storage and get hardcopy output, for measurements such as rise/fall times, pulse widths and time between events.

8560EC RF Spectrum Analyzer

The 8560EC offers excellent performance for RF design, manufacturing and service applications. The 8560EC has a frequency range of 30 Hz to 2.9 GHz. It has synthesized tuning for drift-free accurate measurements.

8562EC RF Spectrum Analyzer

The 8562EC is a midrange performance spectrum analyzer that provides the frequency and dynamic range needed for high-speed digital wireless communication applications. It allows manufacturing and R&D engineers to test network components with state-of-the-art performance. The 8562EC has a frequency range of 30 Hz to 13.2 GHz, which covers the spur-search ranges specified by leading standards organizations in Europe and in the United States.

8563EC Microwave Spectrum Analyzer

The 8563EC extends the outstanding features and capabilities of the 8560EC Series RF spectrum analyzers into the microwave frequency range. The 8563EC has a standard frequency range of 9 kHz to 26.5 GHz (preselected from 2.75 GHz to 26.5 GHz), with optional low-end frequency coverage to 30 Hz. The image-enhanced, double-balanced harmonic mixer of the 8563EC achieves noise-figure performance similar to that of a fundamentally-mixed front end.

8564EC and 8565EC Millimeter-Wave Spectrum Analyzers

Whether you want to measure the third harmonic of a 15 GHz oscillator or the noise sidebands of a 38 GHz carrier, the 8564EC and 8565EC make spectrum analysis easier than ever before. A single coaxial connection is all you need to measure signals from 30 Hz to 50 GHz. Preselection minimizes images and multiple responses at higher frequencies.

The 8564EC has a frequency range of 9 kHz to 40 GHz, the 8565EC of 9 kHz to 50 GHz. Both have optional low-end coverage to 30 Hz and are preselected above 2.75 GHz.

8563E-K35 Adjacent Channel Power Ratio Test Set

Use this special option with the 8562EC/63EC/64EC/65EC spectrum analyzers to increase the dynamic range of ACP measurements. 8563E-K35 uses an alternate first converter mixer with custom filtering to increase the spectrum analyzer's ACPR measurement dynamic range. The dynamic range becomes at least 70 dB for systems with a guard band between channels of 900 kHz or greater. This meets the needs of W-CDMA specifications. Control menus are integrated into the spectrum analyzer softkeys making the test set easy to use.

11970 Series and 11974 Series Millimeter-Wave Mixers

For millimeter-wave measurements¹, preselection can be extended to 75 GHz using the 11974 mixers. Unpreselected frequency range can be extended to 110 GHz using the 11970 series mixers, and to 325 GHz using mixers from other manufacturers.

85620A Mass Memory Module

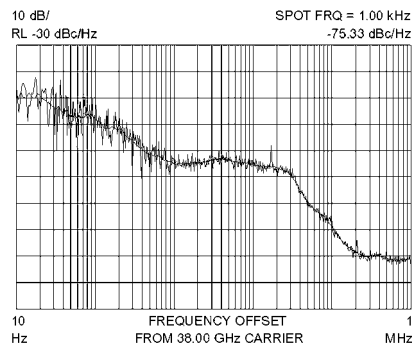
This standard plug-in module adds measurement personality capability, enough memory to store 100 traces, memory-card capability and computer capability, without an external controller. Create complex measurement routines and save them as single-key measurements stored on memory cards or in the module's 128 KB of battery-backed RAM. A clock/calendar and automatic save and execute functions let you configure the spectrum analyzer for unattended, automatic measurements.

85629B Test and Adjustment Module

This accessory for the 8560EC/61EC/63EC (limited use on 8562EC/64EC) makes it easier to service your spectrum analyzer. The module plugs into the rear panel of the instrument and automates high-level diagnostics, self tests and adjustment procedures. It performs more than 1,000 troubleshooting adjustments. Readjustments are fast and accurate because the module controls internal analyzer settings as well as external test equipment.

85671A Phase Noise Measurement Utility

This downloadable program transforms your 8560EC Series spectrum analyzer into a phase noise tester. It eliminates the task of hand-drawing phase noise plots. To measure oscillator phase noise, you can generate graphs of phase noise (dBc/Hz) versus log offset frequency without having to manually tune to multiple frequency offsets. Other productivity features include direct phase noise readout, variable filtering (for controlling trade-offs between measurement repeatability and speed), calculation of RMS noise (displayed in radians and degrees), spot-frequency measurements (phase noise measurements at a single offset frequency) and digitized hardcopy and storage.



Use the 85671A phase noise utility to easily characterize noise sidebands of an oscillator.

85672A Spurious Response Measurements Utility

The 85672A is a downloadable program on a card that inserts directly into any 8560EC Series spectrum analyzer. This test utility provides fast and easy spurious response test capability for all of 8560EC Series spectrum analyzers. Test setup time can be drastically reduced for manufacturing and R&D engineers with this one-button solution. 85672A offers five preprogrammed tests: third-order intermodulation product/third order intercept (TOI), harmonics and total-harmonic distortion (THD), discrete sideband spurs, general-spur search and mixing products.

Scalar Network Analysis Capability

The 85640A tracking generator used with the 8560EC covers 300 kHz to 2.9 GHz, providing 8560EC Series spectrum analyzers with scalar measurement capability.

Specifications

Frequency

Frequency Range (internal mixing)

8560EC: 30 Hz to 2.9 GHz

8562EC: 30 Hz to 13.2 GHz

8563EC: 9 kHz to 26.5 GHz; 30 Hz to 26.5 GHz (Option 006)

8564EC: 9 kHz to 40 GHz; 30 Hz to 40 GHz (Option 006)

8565EC: 9 kHz to 50 GHz; 30 Hz to 50 GHz (Option 006)

Frequency Range (external mixing): 18 GHz to 325 GHz in 12 wave-guide bands

Frequency Reference Accuracy

Temperature Stability	$\pm 1 \times 10^{-8}$
-----------------------	------------------------

Aging (per year)	$\pm 1 \times 10^{-7}$
------------------	------------------------

Settability	$\pm 1 \times 10^{-8}$
-------------	------------------------

Warmup (nominal), 5 minute $\pm 1 \times 10^{-7}$; 15 minute $\pm 1 \times 10^{-8}$

Frequency Readout Accuracy (N = L0 Harmonic)

Span > 2 MHz x N: \pm (freq. readout x freq. ref. accuracy + 5% x span + 15% x RBW + 10 Hz)

Span \leq 2 MHz x N: \pm (freq. readout x freq. ref. accuracy + 1% x span + 15% x RBW + 10 Hz)

For more information, visit our web site:

www.agilent.com/find/8560

¹ Millimeter-wave coverage is not available with Option 002 on the 8560EC.

8560EC
Series
Spectrum
Analyzer

Marker Count Accuracy (S/N ≥ 25 dB): \pm (marker freq. x freq. ref. accuracy + 2 Hz x N + 1 LSD)

Counter Resolution: Selectable from 1 Hz to 1 MHz

Frequency Span

- Range: 0 Hz, 100 Hz to maximum frequency

Sweep Time

- Range
 - Span = 0 Hz: 50 μ s to 6,000 s
 - Span ≥ 100 Hz: 50 ms to 100 ks

Accuracy (span = 0 Hz)

- Sweep Time > 30 ms: $\pm 1\%$ digital
- Sweep Time < 30 ms: $\pm 10\%$ analog; $\pm 0.1\%$ digital

Sweep Trigger: Delayed, free run, single, line, video, external

Resolution Bandwidth:

- Range (-3 dB): 1 Hz to 1 MHz in a 1, 3, 10 sequence and 2 MHz
- Accuracy
 - 1 Hz to 300 kHz: $\pm 10\%$; 1 MHz: $\pm 25\%$; 2 MHz: $+50\%$, -25%
- Selectivity (-60 dB/ -3 dB)
 - RBW ≥ 300 Hz: $< 15:1$; RBW ≤ 100 Hz: $< 5:1$

Video Bandwidth Range: 1 Hz to 3 MHz in a 1, 3, 10 sequence

Noise Sidebands (center frequency ≤ 1 GHz)

- Offset
 - 100 Hz: < -88 dBc/Hz
 - 1 kHz: < -97 dBc/Hz
 - 10 kHz: < -113 dBc/Hz
 - 100 kHz: < -117 dBc/Hz

Residual FM (zero span): < 1 Hz p-p in 20 ms; < 0.25 Hz p-p in 20 ms (nominal); < 10 Hz p-p in 20 μ s (Option 103)

Amplitude

Range: Displayed average noise level to +30 dBm

Maximum Safe Input Level

- Average Continuous Power: +30 dBm (1W, input atten. ≥ 10 dB)
- Peak Pulse Power (< 10 μ s pulse width and $< 1\%$ duty cycle): +50 dBm (100 W, input atten. ≥ 30 dB)
- DC Volts: $\leq \pm 0.2$ V (dc-coupled); $\leq \pm 50$ V (ac-coupled, 8560EC and 8562EC only)

1 dB Gain Compression

- 10 MHz to 2.9 GHz: mixer level ≤ -5 dBm
- 2.9 to 6.5 GHz (8562EC/63EC/64EC/65EC): mixer level ≤ 0 dBm
- > 6.5 GHz: ≤ -3 dBm (8562EC/63EC); ≤ 0 dBm (8564EC/65EC)

Displayed Average Noise Level (0 dB input atten., 1 Hz RBW)

Frequency	8560EC	8562EC	8563EC	8564EC/65EC
30 Hz	-90 dBm	-90 dBm	-90 dBm	-90 dBm
1 kHz	-105 dBm	-105 dBm	-105 dBm	-105 dBm
10 kHz	-120 dBm	-120 dBm	-120 dBm	-120 dBm
100 kHz	-120 dBm	-120 dBm	-120 dBm	-120 dBm
1 to 10 MHz	-140 dBm	-140 dBm	-140 dBm	-140 dBm
10 MHz to 2.9 GHz	-149 dBm	-149 dBm	-149 dBm	-145 dBm
2.9 to 6.5 GHz	—	-148 dBm	-148 dBm	-147 dBm
6.5 to 13.2 GHz	—	-145 dBm	-145 dBm	-143 dBm
13.2 to 22.0 GHz	—	—	-140 dBm	-140 dBm
22.0 to 26.5 GHz	—	—	-139 dBm	-136 dBm
26.5 to 31.15 GHz	—	—	—	-139 dBm
31.15 to 40.0 GHz	—	—	—	-130 dBm
40.0 to 50.0 GHz	—	—	—	-127 dBm ¹

Spurious Responses	Mixer Level	Distortion
General Spurious	-40 dBm	$< (-75 + 20 \log N)$ dBc
Second Harmonic Dist.		
20 MHz to 1.45 GHz	-40 dBm	< -79 dBc
1 MHz to 1.45 GHz	-40 dBm	< -72 dBc
1.45 GHz to 3.25 GHz	-20 dBm	< -72 dBc
1.45 GHz to 2.0 GHz ²	-10 dBm	< -85 dBc
2 GHz to 6.6 GHz	-10 dBm	< -100 dBc
2.0 GHz to 13.25 GHz ³	-10 dBm	< -100 dBc
2.0 GHz to 20 GHz ⁴	-10 dBm	< -90 dBc
20 GHz to 25 GHz ³	-10 dBm	< -90 dBc

Spurious Responses	Mixer Level	Distortion
3rd Order Intermodulation ⁵		
20 MHz to 2.9 GHz	-30 dBm	< -82 dBc
1 MHz to 2.9 GHz	-30 dBm	< -78 dBc
2.9 GHz to 6.5 GHz	-30 dBm	< -90 dBc
6.5 GHz to 26.5 GHz	-30 dBm	< -75 dBc
26.5 GHz to 40 GHz ⁴	-30 dBm	< -85 dBc (nominal)
40 GHz to 50 GHz ¹	-30 dBm	≤ -85 dBc (nominal)

Images

10 MHz to 26.5 GHz	-10 dBm	< -80 dBc
26.5 GHz to 50 GHz	-30 dBm	< -60 dBc

Multiples and Out-of-Band Responses

10 MHz to 26.5 GHz	-10 dBm	< -80 dBc
26.5 GHz to 50 GHz	-30 dBm	< -55 dBc

Residual Responses (> 200 kHz, N=1): < -90 dBm

Display

- Viewing area: Approx. 7 cm (V) x 9 cm (H)
- Scale calibration: 10 x 10 divisions
- Log scale: 10, 5, 2, 1 dB per division
- Linear scale: 10% of ref. level per division

Display Scale Fidelity

- Log: ± 0.1 dB/dB to a maximum of ± 0.85 dB, 0 to -90 dB; maximum of ± 1.5 dB, 0 to -100 dB (RBW ≤ 100 Hz)
- Linear: $\pm 3\%$ of reference level

Reference Level Range: Log = -120 to $+30$ dBm in 0.1 dB steps;

- Linear = 2.2 μ V to 7.07 V in 1% steps

Frequency Response, Relative (10 dB input atten.)

Frequency	8560EC	8562EC	8563EC	8564EC/65EC
100 MHz to 2.0 GHz	± 0.7 dB	± 0.9 dB	± 1.0 dB	± 0.9 dB
30 Hz to 2.9 GHz	± 1.0 dB	± 1.25 dB	± 1.25 dB	± 1.0 dB
2.9 GHz to 6.5 GHz	—	± 1.5 dB	± 1.5 dB	± 1.7 dB
6.5 GHz to 13.2 GHz	—	± 2.2 dB	± 2.2 dB	± 2.6 dB
13.2 GHz to 22.0 GHz	—	—	± 2.5 dB	± 2.5 dB
22.0 GHz to 26.5 GHz	—	—	± 3.3 dB	± 3.3 dB
26.5 GHz to 31.15 GHz	—	—	—	± 3.1 dB
31.15 GHz to 40.0 GHz	—	—	—	± 2.6 dB
40.0 GHz to 50.0 GHz	—	—	—	± 3.2 dB ¹

Calibrator Output: 300 MHz x (1 \pm freq. ref. acc'y), -10 dBm: $\leq \pm 0.3$ dB

Input Attenuator

- Range
 - 8560EC/62EC/63EC: 0 to 70 dB in 10 dB steps
 - 8564EC/65EC: 0 to 60 dB in 10 dB steps
- Switching Uncertainty (ref. to 10 dB, 30 Hz to 2.9 GHz): $\leq \pm 0.6$ dB/10 dB step, ± 1.8 dB max.
- Repeatability: ± 0.1 dB (nominal)

IF Gain Uncertainty (10 dB atten., 0 to -80 dBm ref. level): $\leq \pm 1$ dB

Resolution Bandwidth Switching Uncertainty: $\leq \pm 0.5$ dB

Pulse Digitization Uncertainty (pulse response mode, PRF ≥ 720 /sweep time, RBW ≤ 1 MHz): < 1.25 dB pk-pk (Log); $< 4\%$ of reference level pk-pk (Linear)

Time-Gated Spectrum Analysis

Gate Delay	Edge Mode	Level Mode
Range	3 μ s to 65.535 ms	≤ 0.5 μ s
Resolution	1 μ s	
Accuracy (from gate trigger input to pos. edge of gate output):	$\leq \pm 1$ μ s	

Gate Length

Range: 1 μ s to 65.535 ms
Resolution: 1 μ s
Accuracy (from pos. edge to neg. edge of gate output): $\leq \pm 1$ μ s

¹ 8565EC only.

² 8563EC/64EC/65EC only.

³ 8563EC only.

⁴ 8564EC/65EC only.

⁵ TOI reference to single tone.

Delayed Sweep**Trigger Modes:** Free run, line, external, video**Range:** 2 μ s to 65.535 μ s; Option 007, Sweeptime <30 μ s;
–9.9 μ s to +65.535 μ s; Sweeptime \geq 30 μ s, +2 μ s to +65.535 μ s**Resolution:** 1 μ s**Accuracy:** \pm 1 μ s**Demodulation** (Spectrum)**Modulation Type:** AM and FM**Audio Output:** Speaker and phone jack with volume control**Inputs and Outputs** (All values nominal)**Front-Panel Connectors****RF Input** (50 Ω)

8560EC/62EC/63EC, Type-N female

8563EC Option 026, APC-3.5 male

8564EC/65EC, 2.4-mm male

VSWR (\geq 10 dB atten.): <1.5:1 below 2.9 GHz; <2.3:1, \geq 2.9 GHz**LO Emission Level** (average with 10 dB atten.): <–80 dBm**Second IF Input** (SMA female, 50 Ω)

• Frequency: 310.7 MHz

• Full Screen Level: –30 dBm

• Gain Compression: –20 dBm

First LO Output (SMA female, 50 Ω)

• Frequency: 3.0 to 6.8107 GHz

• Amplitude: 16.5 dBm \pm 2 dB; +14.5 dBm \pm 3 dB (Option 002)**Cal Output:** BNC female, 50 Ω **Probe Power:** +15 Vdc, –12.6 Vdc, and GND (150 mA maximum each)**Rear Panel Connectors****10 MHz Reference In/Out** (shared BNC female, 50 Ω)• Output Freq. Accuracy: 10 MHz \pm (10 x MHz freq. ref. acc'y)

• Output Amplitude: 0 dBm

• Input Amplitude: –2 to +10 dBm

Video Output (BNC, 50 Ω)• Amplitude (RBW \geq 300 Hz): 0 to +1 V full scale**LO Sweep I FAV Output** (shared BNC female, 2 k Ω)

• Amplitude (LO sweep): 0 to 10 V, no load

Blanking/Gate Output: Shared BNC female, 50 Ω , TTL output**External/Gate Trigger Input** (shared BNC female, >10 k Ω): settable to high TTL or low TTL**GPIO** (IEEE-488 bus connector)**Interface Functions:** SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT0, C1, C28, E1**Interface Functions** (For 8562EC): SH1, AH1, T6, LE0, RL1, PP1, DC1, DT1, C1, C28, TE0, SR1**General Specifications****Environmental**

- Military Specs: Class 3 MIL-rugged
- Calibration Interval: Two years (8560EC/61EC/62EC/63EC);
One year (8564EC/65EC)
- Warmup Time: 5 minutes in ambient conditions
- Temperature: 0° to +55°C (operating); –40° to +71°C (not operating)
- Humidity: 95% at 40°C for five days
- Rain Resistance: Drip-proof at 16 liters/hour/sq. ft.
- Altitude: 15,000 ft. (operating); 50,000 ft. (not operating)
- Pulse Shock (half sine): 30 g for 11 ms duration
- Transit Drop: 8-inch drop on six faces and eight corners

Electromagnetic Compatibility: Conducted and radiated interference in compliance with CISPR Pub. 11 (1990). Meets MIL-STD-461C, part 4, with certain exceptions.**Power Requirements**

- 115 Vac Operation: 90 to 140 V rms, 3.2 A rms max., 47 to 440 Hz
- 230 Vac Operation: 180 to 250 V rms, 1.8 A rms max., 47 to 66 Hz

Maximum Power Dissipation: 180 W (8560EC/62EC/63EC);
260 W (8564EC/65EC)**Audible Noise** (nominal): <5.0 Bels power at room temp. (ISO DP7779)**Dimensions** (w/o handle, feet, cover): 187 mm H x 337 mm W x 461 mm D
(7.48 in x 13.34 in x 18.41 in)**Weight** (carrying, nominal)

- Agilent 8560EC/62EC/63EC: 16.3 kg (36 lbs)
- Agilent 8564EC/65EC: 17.3 kg (38 lbs)

Key Literature & Web Link

8560EC Series Configuration Guide, p/n 5968-8155E

8560EC Series Brochure, p/n 5968-9328E

8563E-K35 Product Overview, p/n 5966-2913E

8560EC Series Technical Specifications, p/n 5968-8156E

85671A Product Overview, p/n 5091-7089E

85672A Product Overview, p/n 5965-1337E

85710A Technical Data, p/n 5952-1452

For more information on compatible printers, visit our web site:

www.agilent.com/find/pcg**Ordering Information****8560EC** Spectrum Analyzer, 30 Hz to 2.9 GHz**8562EC** Spectrum Analyzer, 30 Hz to 13.2 GHz**8563EC** Spectrum Analyzer, 9 kHz to 26.5 GHz**8564EC** Spectrum Analyzer, 9 kHz to 40 GHz**8565EC** Spectrum Analyzer, 9 kHz to 50 GHz**Options**

To add options to a product, use the following ordering scheme:

Model: 856xEC (x = 0, 2, 3, 4 or 5)

Example options: 8563EC-006, 8560EC-002

856xEC-001 Add Second IF Output (310.7 MHz); Rear Panel Connector**856xEC-005** Add Alternate Sweep Out (cannot be used with Opt 002)**856xEC-006** Low End Range to 30 Hz (8563EC/64EC/65EC)**856xEC-008** Add Signal Identification**856xEC-026** APC-3.5 mm Input Connector (8563EC)**856xEC-042** Gray Spectrum Analyzer Backpack**856xEC-044** Yellow Spectrum Analyzer Backpack**856xEC-104** Do Not Include Mass Memory Module**856xEC-B70** BenchLink Spectrum Analyzer Software**856xEC-908** Rackmount Kit without Handles**856xEC-909** Rackmount Kit with Handles**856xEC-910** Extra Manual Set**856xEC-915** Service Guide**856xEC-916** Extra Quick Reference Guide (English)**856xEC-1BP** MIL-STD-45662A Calibration with test data**856xEC-UK6** Commercial Calibration (with data)**856xE-K35** ACPR Test Set (8562EC/63EC/64EC/65EC)**Accessories****85629B** Test and Adjustment Module**85640A** Tracking Generator (300 kHz to 2.9 GHz)**8449B** 1 to 26.5 GHz Preamplifier**85700A** 32 KB RAM Memory Card**85671A** Phase Noise Measurements Utility**85672A** Spurious Response Measurements Utility**85902A** Burst Carrier Trigger8560EC
Series
Spectrum
Analyzer

- **Accurate, automated ACP measurements on TDMA and TDD signals**
- **Measure according to NADC-TDMA, PDC, PHS, and other standards**
- **Measurement accelerators speed up ACP testing**
- **Carrier on/off power**
- **Total channel power, percent occupied bandwidth**
- **Burst-timing measurements**

Accurate and Easy-to-Use Power Measurements Using the 8560EC Series Spectrum Analyzers

Many wireless communications systems employ burst-carrier techniques such as time division multiple access (TDMA) and time division duplex (TDD) to maximize system capacity. The 8560EC series spectrum analyzers offer power measurements for both continuous and burst signals that are accurate, and easy to make. Measurement capability includes adjacent channel power (ACP), carrier power, channel power, and occupied bandwidth. These analyzers provide the greatest measurement flexibility and RF performance, making them powerful tools for R&D designers working with current wireless standards, or on systems with standards still under development.

The 8562EC Spectrum Analyzer

The 8562EC Spectrum Analyzer was designed specifically for digital communications. Its frequency coverage of 13.2 GHz means that now you can use the same analyzer for harmonic and spurious testing both in- and out-of-band. The increased dynamic range and third-order intercept (TOI) capability allows wireless communications engineers to test high-performance components in burst operation systems. See page 111 for details.

Measurement Utility Increases Speed and Repeatability

The 85672A Spurious Response Measurements Utility makes measurements fast and easy with the touch of a button. Works on all 8560EC series spectrum analyzers. See page 111 for details.

Adjacent Channel Power

The ability to measure ACP on wireless telephones, pagers, and other transmitters is critical in R&D, manufacturing and in the field. The 8560EC series spectrum analyzers provide ACP measurements for a variety of wireless communication systems, including support for NADC-TDMA, PDC, and PHS digital formats. Many of the implementation difficulties of the established standards have been addressed, providing fast, accurate, and easy-to-use ACP measurements. Use an 8560EC series spectrum analyzer with the 8563EC-K35 APCR test set to meet the needs of the W-CDMA specifications.

In addition to the standard analog method for making ACP measurements (used for FM mobile telephones and continuous digital formats), the analyzers support four other methods used for burst-carrier measurements of TDMA and TDD signals:

- Peak (for PDC and PHS)
- Two-bandwidth (for PDC)
- Time-gated (for NADC-TDMA)
- Burst-power (an Agilent proprietary method)

The burst-power method overcomes many of the problems of the other standards, and is suitable for all formats. These methods can easily be adapted to measure other transmitters besides those used for cellular or cordless telephones. Configuration parameters that can be set by the user include channel spacing and bandwidth, number of alternate channels, burst period and width, and values for root-raised-cosine frequency weighting. Measurement results can be displayed in both graphic and tabular formats for ease of data interpretation and documentation. Measurement accelerators are available that give ACP results in just a few seconds, allowing real-time transmitter adjustments.

Carrier Power

The carrier power feature provides the user with a quick means of measuring the average "on" and "off" power of the burst carrier. This measurement is performed in the time domain, using zero span.

Channel Power

The channel power feature quickly provides the user with information on total power within a specified channel bandwidth, as well as power density within the channel. This feature greatly simplifies this common measurement, as the spectrum analyzer automatically performs the necessary integration across the desired frequency band.

Occupied Bandwidth

Occupied bandwidth is a way of determining the spectral spread of a signal. It is defined as the bandwidth which contains the specified percent of the total transmitted power. The user may specify the percentage to be anywhere from 0.1 to 99.99 percent.

Burst Timing

Complete timing measurements can be made on the burst-carrier signal using digitized, fast time-domain (zero span) sweeps. Using sweep times as fast as 50 μ s, edge times, burst width, and time between bursts can easily be measured.

More Information

More information about the 8560EC series spectrum analyzers, including ordering information, can be found on page 110.

- 30 to 300% faster than other analyzers
- Optional 25 MHz analysis bandwidth
- +15 dBm TOI, -154 dBm/Hz DANL
- 0.3 dB absolute amplitude accuracy
- 78 dB W-CDMA ACLR dynamic range
- Built in one-button measurement applications for Mobile WiMAX™, W-CDMA, HSDPA/HSUPA, phase noise, and more
- World-leading 89601A vector signal analysis software runs inside



Eliminating the Compromise Between Speed and Performance

The MXA signal analyzer drives signal and spectrum analysis to the next level by offering the highest performance in a midrange analyzer and the industry's fastest signal and spectrum analysis.

Fastest Signal Analysis

Design validation and manufacturing floor engineers and managers agree that measurement speed is most critical in achieving their test goals. With this in mind, Agilent continues to compare the MXA's measurement speed against other signal and spectrum analyzers in the industry. The measurement results reveal that the MXA is 30 to 300% faster than other signal or spectrum analyzer regardless of the frequency range. Following are some key benchmark results.

- <14 ms W-CDMA ACLR fast mode measurement speed ($\sigma = 0.2$ dB)
- <5 ms marker peak search
- <51 ms tune, measure, and transfer over GPIB
- <75 ms measurement/mode switching speed for seamless switching between mobile WiMAX, W-CDMA, HSDPA/HSUPA, phase noise, and 89601A VSA (vector signal analysis) software

Highest Performance in a Midrange Signal Analyzer

Fast measurement speed doesn't mean compromising dynamic range. The MXA has the best-in-class dynamic range:

- +15 dBm third-order intercept (TOI)
- -154 dBm/Hz displayed average noise level (DANL)
- 78 dB W-CDMA ACLR dynamic range

With a 2 dB step mechanical attenuator or optional 1 dB step electrical attenuator and 160 resolution bandwidth settings (in 10% incremental steps), the MXA provides you with the best combination of speed and dynamic range.

Electronic Attenuator

The optional 3 GHz electronic attenuator is able to withstand millions of switches. The combination of exceptional measurement speed, user-definable pass/fail capability, and excellent repeatability, due to an all digital IF technology, make the MXA ideal for high-volume, low-cost manufacturing.

25 MHz Analysis Bandwidth

Activate optional 25 MHz analysis bandwidth to make measurements for Mobile WiMAX, multi-carrier W-CDMA, and other wideband signals using:

- 802.16 OFDMA and W-CDMA measurement applications
- 89601A VSA software
- CCDF measurements up to 25 MHz that covers four carrier W-CDMA signal
- 90 Msamples/sec, 14 bit ADC

Fully Calibrated Preamplifiers up to 26.5 GHz

Analyze low level signals on the only midrange analyzer to offer a choice of fully calibrated internal preamplifiers up to 26.5 GHz. You can select preamp frequency up to the maximum frequency of the instrument:

- Four different preamp frequencies are available: 100 kHz to 3.6, 8.4, 13.6 or 26.5 GHz
- Gain +20 dB from 100 kHz to 3.6 GHz and +35 dB from 3.6 to 26.5 GHz

Time Gating

Analyze time varying signals such as WiMAX, pulsed RF, time division multiple access (TDMA), and interleaved and burst-modulated signals with time gating capability. The Agilent MXA offers three types of time gating – gated LO (or gated sweep), gated video, and gated FFT:

- Gated LO offers the fastest time gating measurement for a full span of frequency
- Gated FFT offers the fastest time gating measurement within the span of analysis bandwidth (8 MHz standard, 25 MHz optional)
- Gated video offers the backward compatibility with Agilent ESA, 856x and 859x series spectrum analyzers

List Sweep

Save measurement time by programming the MXA analyzer for fast power measurements using the list sweep feature. Remotely extract amplitude values at known frequencies by making a list of single-point measurements in advance. The MXA can also run through the measurements without requiring you to reset the analyzer for each iteration of a measurement cycle. You can:

- Make multiple zero span measurements at multiple frequencies
- Choose different resolution bandwidths, video bandwidths, detector types, and sweep times at different sweep points
- Obtain peak and average power measurement result

89601A Vector Signal Analysis (VSA) Software Runs in the Instrument

The MXA is the first signal analyzer that has the world's best-selling VSA software running in it. It offers a convenient access to analysis of complex, time-varying signals using the advanced modulation analysis algorithms to help you develop, troubleshoot, and verify the physical layer performance of your radio system. Easily navigate the 89601A VSA user interface using a keyboard and mouse. A 14-day trial version of the 89601A VSA software is included in every MXA signal analyzer. Evaluate the software for free and access the in-depth help file to learn more about the software. See page 124 (where the VSA is described) for further information of VSA.

MATLAB®

MXA officially supports MATLAB. You can run MATLAB and 89601A VSA, the two most popular software products for system designers in the wireless communication industry, in a single instrument. MATLAB support allows you to create custom measurement programs for the MXA. In addition, Agilent provides plenty of sample programs – visit www.agilent.com/find/matlab_sa for drivers, sample programs, and more information.

One-button Power Measurements: Power Suite

The spectrum analysis capability in the MXA provides both standards-based power measurements and enhanced traditional spectrum analysis. Power Suite, a subset of the spectrum analyzer capability, provides a comprehensive set of flexible, one-button RF and microwave power measurements. Wireless standards-based setups include: 2G/3G, WLAN, Bluetooth®, UWB, and S-DMB. Use the more than 75 quick setups or use custom settings for specific power measurements that are not already preconfigured. The Power Suite includes:

- Adjacent channel power (ACP)
- Channel power
- Occupied bandwidth (OBW)
- Spectrum emission mask (SEM)
- Complementary cumulative distribution function (CCDF)
- Burst power
- Spurious emissions

Visit www.agilent.com/find/mxa for the latest set of available measurements and presets for standards.

Auto Tune

Save set-up time with the Auto Tune feature. At the press of a button, a mathematical algorithm is executed that automatically changes the analyzer's center frequency to the strongest signal in the tunable span of the analyzer. It also adjusts the span to three times the occupied bandwidth of the signal, sets the resolution and video bandwidth, optimizes the reference level, performs a peak search, sets a marker on the peak, and displays the measurement result.

Advanced Markers and Traces

Determine the precise value at each trace point quickly with MXA's advanced marker capability. Twelve markers, either frequency or position based, are available. Any marker can be a reference for other markers. Band marker enables easy setup for power ratio measurements such as adjacent channel power (ACP) and noise power ratio (NPR). You can view all readings of the markers on the marker table. You can also display up to six traces, such as a carrier plus up to five harmonics, in the same display window. In addition, you can choose one of detectors (Normal, Average/RMS, Positive peak, Negative peak) to each trace independently.

Built-in Help

Instead of storing and scouring through hundreds of pages of manuals, just press the Help key to evoke a comprehensive context-sensitive help system inside the MXA – any key, any menu, anytime. Use keys on the MXA's front panel to view the rich manual content which also includes handy SCPI programming commands.

**Modern Connectivity**

Take advantage of the modern connectivity as well as the legacy connectivity and backward compatibility:

- Connect your MXA to a LAN and control the MXA remotely – view signals and acquire and analyze waveform data from anywhere in the world using either the embedded web server or Windows Remote Desktop software
- Connect the MXA to the LAN to share files and print to networked computers
- Use IVI-COM drivers for Agilent VEE
- Save time by reusing test code with the MXA's backward code compatibility to the ESA and PSA as well as code written for EXA
- Chose the best connection for your requirements:
 - USB 2.0 – six type A, one type B
 - LAN – 100 based-T
 - GPIB

**LXI class C Compliant (Class-B mid 2008)**

LXI (LAN eXtensions for Instruments), the test-system architecture based on proven, widely used standards such as Ethernet, enables fast, efficient, and cost-effective creation – and reconfiguration – of test systems. The MXA is an LXI class C compliant signal analyzer that can help you and your team open new possibilities in testing.

For more information, visit www.agilent.com/find/lxi

Open Windows® XP Professional Operating System

- Manage files easily and quickly using Windows Explorer
- Run MATLAB and the 89601A vector signal analysis software inside the MXA
- Trouble shoot and control the MXA via Windows Remote Desktop software or with them embedded web server (LXI class C compliant)

Frequency and Time Specifications

Frequency Range

	DC Coupled	AC Coupled
Option 503	20 Hz to 3.6 GHz	10 MHz to 3.6 GHz
Option 508	20 Hz to 8.4 GHz	10 MHz to 8.4 GHz
Option 513	20 Hz to 13.6 GHz	10 MHz to 13.6 GHz
Option 526	20 Hz to 26.5 GHz	10 MHz to 26.5 GHz
Band	LO Multiple (N)	
0	1	20 Hz to 3.6 GHz
1	1	3.5 to 8.4 GHz
2	2	8.3 to 13.6 GHz
3	2	13.5 to 17.1 GHz
4	4	17 to 26.5 GHz

Frequency Reference

Accuracy	$\pm[(\text{time since last adjustment} \times \text{aging rate}) + \text{temperature stability} + \text{calibration accuracy}]$	
Aging rate	Option PFR $\pm 1 \times 10^{-7}/\text{year}$ $\pm 1.5 \times 10^{-7}/2 \text{ years}$	Standard $\pm 1 \times 10^{-6}/\text{year}$
Temperature stability	Option PFR $\pm 1.5 \times 10^{-8}$ $\pm 5 \times 10^{-8}$	Standard $\pm 2 \times 10^{-6}$ $\pm 2 \times 10^{-6}$
Achievable initial calibration accuracy	Option PFR $\pm 4 \times 10^{-8}$	Standard $\pm 1.4 \times 10^{-6}$
Residual FM		
Option PFR	$\leq (0.25 \text{ Hz} \times N)$ p-p in 20 ms nominal	
Standard	$\leq (10 \text{ Hz} \times N)$ p-p in 20 ms nominal	
	See band table above for N (LO Multiple)	

Frequency Readout Accuracy (start, stop, center, marker)
 $\pm (\text{marker frequency} \times \text{frequency reference accuracy} + 0.25\% \times \text{span} + 5\% \times \text{RBW} + 2 \text{ Hz} + 0.5 \times \text{horizontal resolution}^*)$

Marker Frequency Counter

Accuracy	$\pm (\text{marker frequency} \times \text{frequency reference accuracy} + 0.100 \text{ Hz})$
Delta counter accuracy	$\pm (\text{delta frequency} \times \text{frequency reference accuracy} + 0.141 \text{ Hz})$
Counter resolution	0.001 Hz

Frequency Span (FFT and swept mode)

Range	0 Hz (zero span), 10 Hz to maximum frequency of instrument
Resolution Accuracy	2 Hz
Swept	$\pm (0.25\% \times \text{span} + \text{horizontal resolution})$
FFT	$\pm (0.10\% \times \text{span} + \text{horizontal resolution})$

Sweep Time and Triggering

Range	
Span = 0 Hz	1 us to 6000 s
Span ≥ 10 Hz	1 ms to 4000 s
Accuracy	
Span ≥ 10 Hz, swept	$\pm 0.01\%$ nominal
Span ≥ 10 Hz, FFT	$\pm 40\%$ nominal
Span = 0 Hz	$\pm 0.01\%$ nominal
Trigger	
Free run, line, video, external 1, external 2, RF burst, periodic timer	
Trigger delay	
Span = 0 Hz or FFT	-150 to +500 ms
Span ≥ 10 Hz, swept	1 us to 500 ms
Resolution	0.1 us

Sweep (trace) Point Range

All spans	1 to 20001
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Time Gating

Gate method	Gated LO; Gated video; Gated FFT
Gate length (except method:FFT)	100 ns to 5 s
Gate delay range	0 to 100 s
Gate delay jitter	33.3 ns p-p (nominal)

Resolution Bandwidth (RBW)

Range (-3.01 dB bandwidth)	1 Hz to 3 MHz (10% steps), 4, 5, 6, 8 MHz
Bandwidth accuracy (power)	
RBW range:	
1 Hz to 750 kHz	$\pm 1.0\%$ ($\pm 0.044 \text{ dB}$)
820 kHz to 1.2 MHz ($<3.6 \text{ GHz CF}$)	$\pm 2.0\%$ ($\pm 0.088 \text{ dB}$)
1.3 to 2.0 MHz ($<3.6 \text{ GHz CF}$)	$\pm 0.07 \text{ dB nominal}$
2.2 to 3 MHz ($<3.6 \text{ GHz CF}$)	$\pm 0.15 \text{ dB nominal}$
4 to 8 MHz ($<3.6 \text{ GHz CF}$)	$\pm 0.25 \text{ dB nominal}$
Bandwidth accuracy (-3.01 dB)	
RBW range (1 Hz to 1.3 MHz)	$\pm 2\%$ nominal
Selectivity (-60 dB/-3 dB)	4.1:1 nominal

Analysis Bandwidth

Maximum bandwidth	
Option B25	25 MHz
Standard	10 MHz

Video Bandwidth (VBW)

Range	1 Hz to 3 MHz (10% steps), 4, 5, 6, 8 MHz and wide open (labeled 50 MHz)
Accuracy	$\pm 6\%$ nominal

Stability

See Phase noise under Dynamic Range Specification

Measurement Speed

Local measurement and display update rate	Sweep points = 1001 11 ms (90/s) nominal
Remote measurement and LAN transfer rate	Sweep points = 1001 4 ms (250/s) nominal 5 ms nominal
Marker peak search	
Center frequency tune and transfer (RF)	51 ms nominal
Center frequency tune and transfer (μV)	86 ms nominal
Measurement/mode switching	75 ms nominal

Amplitude Accuracy and Range Specifications

Amplitude Range

Measurement range	Displayed average noise level (DANL) to maximum safe input level
Input attenuator range (20 Hz to 26.5 GHz)	0 to 70 dB in 2 dB steps

Electronic Attenuator (Option EA3)

Frequency range	20 Hz to 3.6 GHz
Attenuation range	
Electronic attenuator range	0 to 24 dB, 1 dB steps
Full attenuation range (mechanical + electronic)	0 to 94 dB, 1 dB steps

Maximum Safe Input Level

Average total power	+30 dBm (1 W)
Preamp	
(Option P03, P08, P13, P26)	+25 dBm
Peak pulse power	<10 us pulse width, <1% duty cycle and +50 dBm (100 W) input attenuation $\geq 30 \text{ dB}$

DC volts	
DC coupled	$\pm 0.2 \text{ Vdc}$
AC coupled	$\pm 70 \text{ Vdc}$

Display Range

Log scale	0.1 to 1 dB/division in 0.1 dB steps 1 to 20 dB/division in 1 dB steps (10 display divisions)
Linear scale	10 divisions
Scale units	dBm, dBmV, dB μV , dBmA, dB μA , V, W, A

* Horizontal resolution is span/(sweep points - 1)

N9020A

Frequency Response(10 dB input attenuation, 20 to 30°C, preselector centering applied, σ = nominal standard deviation)

	Specification	95 th Percentile ($\approx 2\sigma$)
20 Hz to 10 MHz	± 0.6 dB	± 0.28 dB
10 MHz to 3.6 GHz	± 0.45 dB	± 0.17 dB
3.5 to 8.4 GHz	± 1.5 dB	± 0.48 dB
8.3 to 13.6 GHz	± 2.0 dB	± 0.47 dB
13.5 to 22.0 GHz	± 2.0 dB	± 0.52 dB
22.0 to 26.5 GHz	± 2.5 dB	± 0.71 dB
Preamp on (Option P03, P08, P13, P26, 0 dB attenuation)		
100 kHz to 3.6 GHz	± 0.75 dB	± 0.28 dB
3.5 to 8.4 GHz	± 2.0 dB	± 0.53 dB
8.3 to 13.6 GHz	± 2.3 dB	± 0.60 dB
13.5 to 17.1 GHz	± 2.5 dB	± 0.81 dB
17.0 to 22.0 GHz	± 2.5 dB	± 0.81 dB
22.0 to 26.5 GHz	± 3.5 dB	± 1.25 dB

Input Attenuation Switching Uncertainty

50 MHz	
(reference frequency)	± 0.20 dB (± 0.08 dB typical)
attenuation > 2 dB	
20 Hz to 3.6 GHz	± 0.3 dB nominal
3.5 to 8.4 GHz	± 0.5 dB nominal
8.3 to 13.6 GHz	± 0.7 dB nominal
13.5 to 26.5 GHz	± 0.7 dB nominal

Total Absolute Amplitude Accuracy(10 dB attenuation, 20 to 30°C, 1 Hz \leq RBW \leq 1 MHz, input signal -10 to -50 dBm, all settings auto-coupled except Auto Swp Time = Accy, any reference level, any scale, σ = nominal standard deviation)

At 50 MHz	± 0.33 dB
At all frequencies	$\pm (0.33$ dB + frequency response)
20 Hz to 3.6 GHz	± 0.24 dB (95 th Percentile $\approx 2\sigma$)

Preamp On (Option P03, P08, P13, P26)At all frequencies $\pm (0.39$ dB + frequency response)**Input Voltage Standing Wave Ratio (VSWR)**(≥ 10 dB input attenuation)

10 MHz to 3.6 GHz	< 1.2:1 nominal
3.6 to 8.4 GHz	< 1.5:1 nominal
8.4 to 13.6 GHz	< 1.6:1 nominal
13.6 to 26.5 GHz	< 1.9:1 nominal

Preamp On (Option P03, P08, P13, P26, 0 dB attenuation)

10 MHz to 3.6 GHz	< 1.7:1 nominal
3.6 to 8.4 GHz	< 1.8:1 nominal
8.4 to 13.6 GHz	< 2.0:1 nominal
13.6 to 26.5 GHz	< 2.0:1 nominal

Resolution Bandwidth Switching Uncertainty

(referenced to 30 kHz RBW)

1 Hz to 1.5 MHz RBW	± 0.05 dB
1.6 MHz to 3 MHz RBW	± 0.10 dB
4, 5, 6, 8 MHz RBW	± 1.0 dB

Reference Level

Range:

Log scale	-170 to $+30$ dBm in 0.01 dB steps
Linear scale	Same as Log (707 pV to 7.07 V)
Accuracy	0 dB

Display Scale Switching Uncertainty

Switching between linear and log	0 dB
Log scale/div switching	0 dB

Display Scale Fidelity

Between -10 dBm and -80 dBm input mixer level	± 0.10 dB total
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Trace Detectors

Normal, peak, sample, negative peak, log power average, RMS average, and voltage average

Preamplifier**Frequency Range**

Option P03	100 kHz to 3.6 GHz
Option P08	100 kHz to 8.4 GHz
Option P13	100 kHz to 13.6 GHz
Option P26	100 kHz to 26.5 GHz

Gain

100 kHz to 3.6 GHz	+20 dB nominal
3.6 to 26.5 GHz	+35 dB nominal

Noise Figure

100 kHz to 3.6 GHz	11 dB nominal
3.6 to 8.4 GHz	9 dB nominal
8.4 to 13.6 GHz	10 dB nominal
13.6 to 26.5 GHz	15 dB nominal

Dynamic Range Specifications**1 dB Gain Compression (two-tone)**

	Total Power at Input Mixer	
20 to 500 MHz	0 dBm	+3 dBm typical
500 MHz to 3.6 GHz	+3 dBm	+7 dBm typical
3.6 GHz to 26.5 GHz	0 dBm	+4 dBm typical
Preamp On (Option P03, P08, P13, P26)		
10 MHz to 3.6 GHz		-10 dBm nominal
3.6 to 26.5 GHz		
Tone spacing 100 kHz to 20 MHz		-26 dBm nominal
Tone spacing > 70 MHz		-16 dBm nominal

Displayed Average Noise Level (DANL)

(Input terminated, sample or averaging type = Log, 0 dB input attenuation, IF Gain = High, 20 to 30°C.)

Preamp Off	Specification	Typical
9 kHz to 1 MHz		-125 dBm
1 to 10 MHz	-150 dBm	-153 dBm
10 MHz to 2.1 GHz	-151 dBm	-154 dBm
2.1 to 3.6 GHz	-149 dBm	-152 dBm
3.6 to 8.4 GHz	-149 dBm	-153 dBm
8.4 to 13.6 GHz	-148 dBm	-151 dBm
13.6 to 17.1 GHz	-144 dBm	-147 dBm
17.1 to 20.0 GHz	-143 dBm	-146 dBm
20.0 to 26.5 GHz	-136 dBm	-142 dBm
Preamp On (Option P03, P08, P13, P26)		
100 kHz to 1 MHz		-149 dBm
1 to 10 MHz	-161 dBm	-163 dBm
10 MHz to 2.1 GHz	-163 dBm	-166 dBm
2.1 to 3.6 GHz	-162 dBm	-164 dBm
3.6 to 8.4 GHz	-162 dBm	-166 dBm
8.4 to 13.6 GHz	-162 dBm	-165 dBm
13.6 to 17.1 GHz	-159 dBm	-163 dBm
17.1 to 20.0 GHz	-157 dBm	-161 dBm
20.0 to 26.5 GHz	-152 dBm	-157 dBm

Spurious Responses**Residual Responses**

(Input terminated and 0 dB attenuation)

200 kHz to 8.4 GHz (swept)	-100 dBm
Zero span or FFT or other frequencies	-100 dBm nominal

Image Responses

10 MHz to 3.6 GHz	-80 dBc (-107 dBc typical)
3.6 to 13.6 GHz	-78 dBc (-88 dBc typical)
13.6 to 17.1 GHz	-74 dBc (-85 dBc typical)
17.1 to 22 GHz	-70 dBc (-82 dBc typical)
22 to 26.5 GHz	-68 dBc (-78 dBc typical)

LO Related Spurious

(f > 600 MHz from carrier)

10 MHz to 3.6 GHz	-90 dBc typical
Other spurious f ≥ 10 MHz from carrier	-80 dBc

Second Harmonics Distortion (SHI)

	Mixer level	Distortion	SHI
10 MHz to 1.8 GHz	-15 dBm	-60 dBc	+45 dBm
1.8 to 7.0 GHz	-15 dBm	-80 dBc	+65 dBm
7.0 to 11.0 GHz	-15 dBm	-70 dBc	+55 dBm
11.0 to 13.25 GHz	-15 dBm	-65 dBc	+50 dBm

Preamp On (Option P03, P08, P13, P26)

	Preamp level	Distortion	SHI
10 MHz to 1.8 GHz	-45 dBm	-78 dBc nominal	+33 dBm nominal
1.8 to 13.25 GHz	-50 dBm	-60 dBc nominal	+10 dBm nominal

Third-order Intermodulation Distortion (TOI)

(two -30 dBm tones at input mixer with tone separation >5 times IF prefilter bandwidth, 20 to 30°C, see Specifications Guide for IF prefilter bandwidths)

	Distortion	TOI	Typical
10 to 100 MHz	-84 dBc	+12 dBm	+17 dBm
100 to 400 MHz	-88 dBc	+14 dBm	+18 dBm
400 MHz to 1.7 GHz	-90 dBc	+15 dBm	+19 dBm
1.7 to 3.6 GHz	-92 dBc	+16 dBm	+19 dBm
3.6 to 8.4 GHz	-90 dBc	+15 dBm	+18 dBm
8.4 to 13.6 GHz	-90 dBc	+15 dBm	+18 dBm
13.6 to 26.5 GHz	-80 dBc	+10 dBm	+14 dBm

Preamp on (Option P03, P08, P13, P26)

(two -45 dBm tones at preamp input)	
10 to 500 MHz	+4 dBm nominal
500 MHz to 3.6 GHz	+5 dBm nominal
3.6 to 26.5 GHz	-15 dBm nominal

Phase Noise

Noise sidebands (20 to 30°C, CF = 1 GHz)

Offset	Specification	Typical
100 Hz	-84 dBc/Hz	-88 dBc/Hz
1 kHz		-100 dBc/Hz nominal
10 kHz	-103 dBc/Hz	-106 dBc/Hz
100 kHz	-115 dBc/Hz	-117 dBc/Hz
1 MHz	-133 dBc/Hz	-137 dBc/Hz
10 MHz		-148 dBc/Hz nominal

Power Suite Measurement Specifications**Channel Power**

Amplitude accuracy, W-CDMA or IS-95 (20 to 30°C, attenuation = 10 dB): ±0.80 dB (±0.30 dB 95th percentile)

Occupied Bandwidth (OBW)

Frequency accuracy ±[span/1000] nominal

Adjacent Channel Power (ACP)

Accuracy, W-CDMA (ACLR)

(at specific mixer levels

and ACLR ranges)	Adjacent	Alternate
MS	±0.14 dB	±0.21 dB
BTS	±0.49 dB	±0.44 dB

Dynamic range (typical)

Without noise correction	-73 dB	-79 dB
With noise correction	-78 dB	-82 dB

Offset channel pairs measured 1 to 6

ACP speed (fast method). Data measurement and transfer time:

14 ms nominal ($\sigma = 0.2$ dB)

ACPR dynamic range, W-CDMA (5 MHz offset, RRC weighted, 3.84 MHz noise bandwidth)

Two carriers	-70 dB nominal
Four carriers	-64 dB nominal
With noise correction	-72 dB nominal

ACPR accuracy (two carriers, 5 MHz offset, -48 dBc ACPR):

±0.42 dB nominal

Multiple number of carriers measured: Up to 12

Power Statistics CCDF

Histogram resolution 0.01 dB

Spurious Emission

W-CDMA (1 to 3.6 GHz)

Table driven spurious signals; search across regions.

Dynamic range	95.3 dB (100.3 dB typical)
Absolute sensitivity	-84.4 dBm (-89.4 dBm typical)

Spectrum Emission Mask (SEM)

cdma2000 (750 kHz offset)

Relative dynamic range (30 kHz RBW)	78.9 dB (85.0 dB typical)
Absolute sensitivity	-99.7 dBm (-104.7 dBm typical)
Relative accuracy	±0.11 dB
3GPP W-CDMA (2.515 MHz offset)	
Relative dynamic range (30 kHz RBW)	81.9 dB (88.2 dB typical)
Absolute sensitivity	-99.7 dBm (-104.7 dBm typical)
Relative accuracy	±0.12 dB

General Specifications**Temperature Range**

Operating	5 to +50°C
Storage	-40 to +65°C

EMC

Complies with European EMC Directive 89/336/EEC,

amended by 93/68/EEC

IEC/EN 61326

CISPR Pub 11 Group 1, class A

AS/NZS CISPR 11:2002

ICES/NMB-001

Safety

Complies with European Low Voltage Directive 73/23/EEC,

amended by 93/68/EEC

IEC/EN 61010-1

Canada: CSA C22.2 No.61010-1

USA: UL 61010-1

Audio Noise

Acoustic noise emission	Geraeuschemission
LpA <70 dB	LpA <70 dB
Operator position	Am Arbeitsplatz
Normal position	Normaler Betrieb
Per ISO 7779	Nach DIN 45635 t.19

Environmental Stress

Samples of this product have been type tested in accordance with the Agilent Environmental Test Manual and verified to be robust against the environmental stresses of storage, transportation and end-use; those stresses include but are not limited to temperature, humidity, shock, vibration, altitude and power line conditions. Test methods are aligned with IEC 60068-2 and levels are similar to MIL-PRF-2800F Class 3.

Power Requirements

Voltage and frequency (nominal)	100/120 V, 50/60 Hz
	220/240 V, 50/60 Hz

Power Consumption

On	< 260 watts
Standby	< 20 watts

Data Storage

Internal	40 GB nominal
External	Supports USB 2.0 compatible memory devices

Weight (without options)

Net	16 kg (35 lbs) nominal
Shipping	28 kg (62 lbs) nominal

Dimensions

Height	177 mm (7.0 in)
Width	426 mm (16.8 in)
Length	368 mm (14.5 in)

Warranty

The MXA signal analyzer is supplied with a one-year warranty.

Calibration Cycle

The recommended calibration cycle is one year. Calibration services are available through Agilent service centers.

Input and Outputs

Front Panel

RF input	
Connector	Type-N female, 50 ohm nominal
Probe power	
Voltage/current	+15 Vdc, $\pm 7\%$ at 150 mA max nominal –12.6 Vdc, $\pm 10\%$ at 150 mA max nominal

USB 2.0 ports	
Master (2 ports)	
Standard	Compatible with USB 2.0
Connector	USB Type-A female
Output current	0.5 A nominal

Rear Panel

10 MHz out	
Connector	BNC female, 50 ohm nominal
Output amplitude	≥ 0 dBm nominal
Frequency	10 MHz \pm (10 MHz x frequency reference accuracy)

Ext Ref in	
Connector	BNC female, 50 ohm nominal
Input amplitude range	–5 to +10 dBm nominal
Input frequency	1 to 50 MHz nominal
Frequency lock range	$\pm 5 \times 10^{-6}$ of specified external reference input frequency

Trigger 1 and trigger 2 inputs	
Connector	BNC female
Impedance	>10 kOhm nominal
Trigger level range	–5 to +5 V

Trigger 1 and trigger 2 outputs	
Connector	BNC female
Impedance	50 Ohm nominal
Level	5 V TTL nominal

Sync (reserved for future use)	
Connector	BNC female

Monitor output	
Connector	VGA compatible, 15-pin mini D-SUB
Format	XGA (60 Hz vertical sync rates, non-interlaced) Analog RGB
Resolution	1024 x 768

Noise source drive +28 V (pulsed) (reserved for future use)	
Connector	BNC female

SNS series noise source (reserved for future use)

Digital bus (reserved for future use)	
Connector	MDR-80

Analog out (reserved for future use)	
Connector	BNC female

USB 2.0 ports	
Master (4 ports)	
Standard	Compatible with USB 2.0
Connector	USB Type-A female
Output current	0.5 A nominal
Slave (1 port)	
Standard	Compatible with USB 2.0
Connector	USB Type-B female
Output current	0.5 A nominal

GPIB interface	
Connector	IEEE-488 bus connector
GPIB code	SH1, AH1, T6, SR1, RL1, PP0, DC1, C1, C2, C3, C28, DT1, L4, C0

LAN TCP/IP interface	
Standard	100BaseT
Connector	RJ45 Ethertwist

Accessories

Additional accessories provide more protection for your MXA signal analyzer in tough environments.

N9020A-HTC MXA Hard Transit Case

Ultra-durable wheeled carrying case offers maximum protection and portability. This transit case comes with retractable handle, edge casters, and bumpers. A custom cut polyethylene foam insert provides additional protection for your MXA signal analyzer.

N9020A-PRC MXA Portable Configuration

Add a convenient pivoting carrying handle and rubber protective corner and end guards. This configuration is intended for applications requiring more rugged packaging, such as in the field. Front panel protective cover is included in both the standard and portable configurations.

Key Literature & Web Link

Agilent MXA Signal Analyzer Data Sheet, p/n 5898-4942EN
 Agilent MXA Signal Analyzer Configuration Guide, p/n 5989-4943EN
 Agilent MXA Signal Analyzer Photo Card, p/n 5989-4940EN
 Agilent MXA Brochure, p/n 5989-5047EN
 Agilent MXA Demonstration Guide, p/n 5989-6126EN
 Select the Right Agilent Signal Analyzer for Your Needs, Selection Guide, p/n 5968-3413E
 Spectrum Analysis Basics Application Note 150, p/n 5952-0292
 Vector Signal Analysis Basics Application Note 150-15, p/n 5989-1121EN
 89600 Series Vector Signal Analysis Software Technical Overview, p/n 5989-1679
 Using the Agilent MXA Signal Analyzer for Measuring and Troubleshooting Digitally Modulated Signals Application Note, p/n 5989-4944EN
 Using MXA Preselector Tuning for Amplitude Accuracy in Microwave Spectrum Analysis Application Note, p/n 5989-4946EN
 Maximizing Measurement Speed with the Agilent MXA Signal Analyzer Application Note, p/n 5989-4947EN

For more information on MXA please visit:

www.agilent.com/find/mxa

Ordering Information

For further information, refer to MXA Signal Analyzer Configuration Guide (5989-4943EN)

Hardware

N9020A MXA Signal Analyzer

N9020A-503 Frequency Range, 20 Hz to 3.6 GHz
N9020A-508 Frequency Range, 20 Hz to 8.4 GHz
N9020A-513 Frequency Range, 20 Hz to 13.6 GHz
N9020A-526 Frequency Range, 20 Hz to 26.5 GHz
N9020A-B25 Analysis Bandwidth, 25 MHz
N9020A-PFR Precision Frequency Reference (variable)
N9020A-EA3 Electronic Attenuator, 3.6 GHz
N9020A-P03 Preamplifier, 3.6 GHz
N9020A-P08 Preamplifier, 8.4 GHz
N9020A-P13 Preamplifier, 13.6 GHz
N9020A-P26 Preamplifier, 26.5 GHz
N9020A-ESC External Source Control (available 2008)
N9020A-CPU Instrument security, additional CPU/HDD

Accessories

N9020A-MSE Mouse
N9020A-KYB Keyboard
N9020A-EFM USB Flash Drive, 512 MB
N9020A-DVR USB DVD-ROM/CD-R/RW Drive
N9020A-MLP Minimum Loss Pad, 50 to 75 ohm
N9020A-PRC Portable Configuration
N9020AK-CVR Front Panel Cover, additional
N9020A-1CP Rack Mount and Handle Kit
N9020A-1CM Rack Mount Kit
N9020A-1CN Front Handle Kit
N9020A-1CR Rack Slide Kit
N9020A-HTC Hard Transit Case

Applications

See page 123 X-series measurement application section

Documentation

N9020A-1A7 ISO17025 Compliant Calibration
N9020A-A6J ANSI Z540 Compliant Calibration
N9020A-AB1 Getting Started Korean
N9020A-ABJ Getting Started Japanese
N9020A-ABD Getting Started German
N9020A-ABF Getting Started French
N9020A-AKT Getting Started Russian

Warranty and Service

Standard warranty is one year

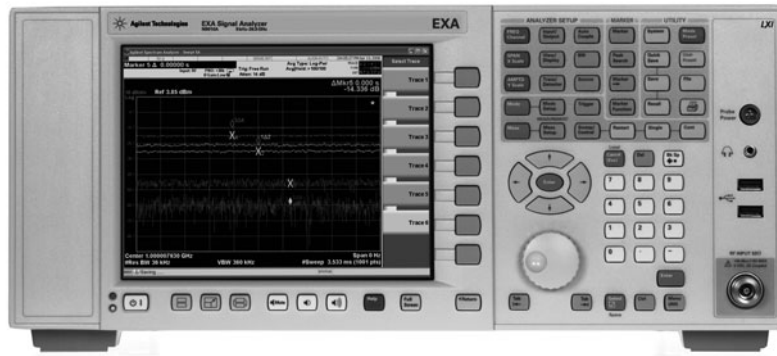
R-51B-001-3C 1 year return-to-Agilent warranty extended to 3 years

Calibration (Options not available in all countries)

R-50C-011-3 Inclusive calibration plan, 3 year coverage

R-50C-013-3 Inclusive calibration plan and cal data, 3 year coverage

- **Make affordable, highly accurate general-purpose measurements with -160 dBm/Hz DANL using the 3.6 GHz preamplifier option**
- **Advanced troubleshooting with capabilities formerly found only on high-end signal analyzers such as: fast mode switching, 4-ms peak search, six independent traces, 12 markers, band power markers, and extensive peak table**
- **Utilize the broadest application coverage available in an economy-class signal analyzer with shared applications common to EXA and MXA signal analyzers including phase noise, noise figure, and analog demodulation**
- **Analyze modulated signals with Agilent's leading 89601A vector signal analysis software running inside the EXA on an open Windows platform**
- **Choose and use the connectivity you need with included GPIB, 100BASE-T LAN and USB 2.0 ports – now LXI class C compliant**



The Agilent EXA Economy Signal Analyzer offers unprecedented speed, accuracy, and application coverage for an economy class instrument.

Make Every Millisecond Count

From product design to the production line, every device demands decisions that require tradeoffs in your goals – product specifications, throughput and yield. Whether you're focused on time-to-market, time-to-volume or cost of test, your choice of economy-class signal analyzer should help you save both time and money. The Agilent EXA signal analyzer makes this possible by eliminating the compromise between speed and price. In addition, the outstanding accuracy of the EXA lets you accelerate the transition from design into manufacturing and helps reduce your overall cost of test. When you need speed without compromise, the Agilent EXA signal analyzer lets you make every millisecond count.

Enhance Yield and Throughput with Excellent Speed and Accuracy

- Improve test-system throughput with capabilities such as fast (10-ms) remote sweep and trace transfer
- Make highly accurate general-purpose measurements – affordably
- Characterize signal quality with a suite of fast, one-button RF power measurements
- Build on the familiarity of ESA Series – the world's most popular economy spectrum analyzer – and the benefits of ESA/EXA code compatibility

Highest Performance in an Economy Class Signal Analyzer

Fast measurement speed doesn't mean compromising dynamic range. With optional 2 dB step mechanical attenuator or 1 dB step electrical attenuator and 160 resolution bandwidth settings (in 10% incremental steps), the EXA provides you with the best combination of speed and dynamic range. EXA's electronic attenuator is able to withstand millions of switches – making it ideal for high speed manufacturing.

89601A Vector Signal Analysis (VSA) Software Runs in the Instrument

The EXA has the world's best-selling VSA software running in it. It offers a convenient access to analysis of complex, time-varying signals using the advanced modulation analysis algorithms to help you develop, troubleshoot, and verify the physical layer performance of your radio system. Easily navigate the 89601A VSA user interface using a keyboard and mouse. A 14-day trial version of the 89601A VSA software is included in every EXA signal analyzer. Evaluate the software for free and access the in-depth help file to learn more about the software. See page 124 for further information of VSA software.

Simplify Manual Testing with An Advanced – Yet Familiar – User Interface

- Save time and effort with capabilities such as fast mode switching, 4-ms peak search, six independent traces, 12 markers, band power markers and a peak table
- Transfer test results quickly and easily via built-in 100BASE-T LAN and USB 2.0 ports
- Ensure easy operation and connectivity through the familiarity and openness of Windows®

Reach New Insights Faster with Versatile Measurement Capabilities

- Confidently pinpoint signal quality issues with accurate measurements
- Perform advanced troubleshooting with capabilities formerly found only on high-end signal analyzers
- Utilize the broadest application coverage available in an economy-class signal analyzer including the 89600 vector signal analysis software, phase noise, analog demodulation and noise figure
- Enhance the EXA with easy updates as test needs and budgets evolve
- Address the latest standards – W-CDMA/HSDPA/HSUPA, GSM/EDGE, cdma2000, Mobile WiMAX – with specific measurement applications and a suite of fast, one-button RF power measurements
- Run applications such as MATLAB inside the EXA

N9010A

Enhanced Standard Features**Auto Tune**

At the press of a button, the analyzers center frequency adjusts to the strongest signal in the tunable span of the analyzer, changes the span to three times the occupied bandwidth of the signal, sets the resolution and video bandwidth, optimizes the reference level, performs a peak search, sets a marker on the peak, and displays the measurement result. This is a patented Agilent exclusive feature.

Advanced Markers and Traces

Determine the precise value at each trace point quickly with the advance marker capability. Twelve independent markers, based on frequency or position, can be set as a reference for any other marker. Band marker enables easy setup for power ratio measurements and results can be viewed on the marker table. Display up to six traces, in the same display window, each with independent detectors.

Built in Help

Instead of searching through hundreds of pages in a manual, just press Help key to evoke comprehensive help system inside the EXA – any key, any menu, anytime. This includes handy SCPI programming commands.

Time Gating

Analyze time varying signals such as WiMAX, pulsed RF, time division multiple access (TDMA), interleaved and burst-modulated with time gating capability. The Agilent EXA offers three types of Time Gating: Gated LO (or Gated sweep), Gated Video and Gated FFT.

- Gated LO offers the fastest Time Gating measurement for full span of frequency
- Gated FFT offers the fastest Time Gating measurement within the span of analysis bandwidth (10 MHz)
- Gated Video offers the backward compatibility with Agilent ESA, 856x and 859x series spectrum analyzers

List Sweep

Save measurement time by programming the EXA analyzer for fast power measurements using the list sweep feature. Remotely extract amplitude values at known frequencies by making a list of single-point measurements in advance. The EXA can run through the measurements without requiring you to reset the analyzer for any iteration of a measurement cycle.

MATLAB

Agilent supports MATLAB driver officially allowing you to run MATLAB and 89601A VSA, which are the two most popular software products for system designers in the wireless communication industry. Agilent also provides sample programs at: www.agilent.com/find/matlab_sa

Advanced Measurement Applications

Please see the measurement application section on page 123 for standards based, one-button measurement applications such as: phase noise, noise figure, analog demodulation, WiMAX, GSM/Edge, cdma2000, and W-CDMA. These advanced measurements applications can be used on the economy class EXA or our mid range MXA.

Specifications

For full specification information please see www.agilent.com/find/exa

Key Literature & Web Link

www.agilent.com/find/exa

Ordering Information**Instrument**

N9010A MXA Signal Analyzer

(includes spectrum analyzer measurement application)

N9010A-503 Frequency Range, 9 kHz to 3.6 GHz, non-upgradeable

N9010A-507 Frequency Range, 9 kHz to 7.0 GHz, non-upgradeable

N9010A-513 Frequency Range, 9 kHz to 13.6 GHz, non-upgradeable

N9010A-526 Frequency Range, 9 kHz to 26.5 GHz, non-upgradeable

N9010A-PRC Portable configuration, upgradeable

Performance Options

N9010A-PFR Precision Frequency Reference, upgradeable

N9010A-EA3 Electronic Attenuator, 3.6 GHz, upgradeable

N9010A-FSA Fine Step Attenuator, upgradeable

N9010A-P03 Preamplifier, 3.6 GHz, upgradeable

Accessories

N9010A-EFM USB Flash Drive, 512 MB, upgradeable

N9010A-DVR USB DVD-ROM/CD-R/RW Drive, upgradeable

N9010A-MSE Mouse, USB Interface, upgradeable

N9010A-KYB Keyboard, USB Interface, upgradeable

N9010A-MLP Minimum Loss Pad, 50 to 75 ohms (Type N to BNC), upgradeable

N9010A-CVR Front Panel Protective Cover, upgradeable

N9010A-HTC Hard Transit Case, upgradeable

N9010A-1CP Rack Mount Kit with Handles, upgradeable

N9010A-1CN Front Handle Kit, upgradeable

N9010A-1CM Rack Mount Kit, upgradeable

N9010A-1CR Rack Slide Kit, upgradeable

Measurement Applications

(can also be used on the MXA midrange signal analyzer)

N9075A WiMAX 802.16-OFDMA Measurement Application, upgradeable

N9073A-1FP W-CDMA Measurement Application, upgradeable

N9073A-2FP HSDPA/HSUPA Measurement Application (requires 1FP), upgradeable

N9068A Phase Noise Measurement Application, upgradeable

89601A 89601A Vector Signal Analysis (VSA) Software, upgradeable

Warranty and Service

Standard warranty is one year

R-51B-001-3C 1 year return-to-Agilent warranty extended to 3 years

Calibration (Options not available in all countries)

R-50C-011-3 Inclusive calibration plan, 3 year coverage

R-50C-013-3 Inclusive calibration plan and cal data, 3 year coverage

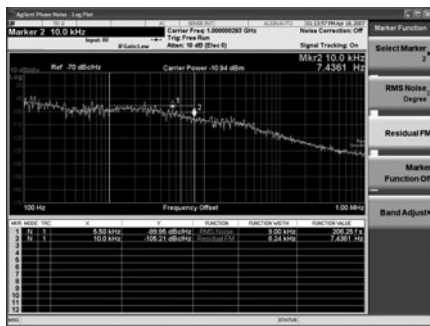
X-Series Advanced Measurement Application Software for EXA and MXA Signal Analyzers

A growing list of X-Series advanced measurement applications available for the MXA and EXA signal analyzers increase the capability and functionality of the analyzers to speed your time to insight. These software measurement applications provide essential measurements for specific tasks. For example, use the W-CDMA measurement application to quickly perform 3GPP standard-based modulation, spectrum, and power tests with confidence.

The application software is identical for MXA and EXA including the same functionality, measurements, and user interface. The only difference is the level of performance achieved by the instrument hardware selected. Choose the level of performance necessary for the application and have full assurance the calculations and algorithms are the same across your MXA and EXA signal analyzers, from the development lab and into manufacturing.

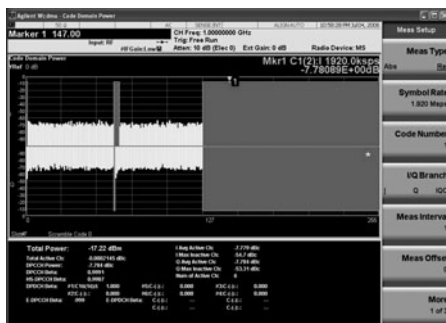
Phase Noise Measurement Application (N9068A)

The Agilent N9068A phase noise measurement application provides plots, traces, and tabular results and has pass/fail tests for clear indication of test results. Features include a customizable range table, log plot, and spot frequency results.



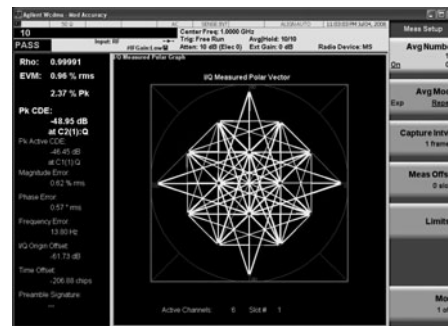
W-CDMA Measurement Application (N9073A-1FP)

For 3GPP W-CDMA Release 99 through Release 6, the W-CDMA measurement application provides simple one-button power measurements, and in-depth modulation analysis for conformance test requirements. Available measurements include modulation analysis such as composite EVM and code domain analysis, and RF measurements such as channel power, ACP, SEM, and more. The application supports BTS and MS measurements.



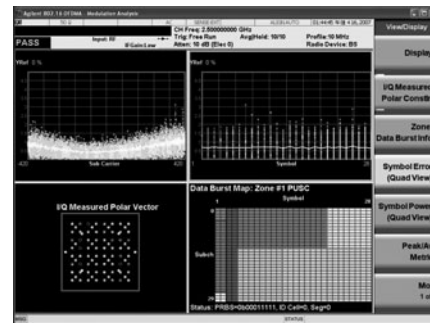
HSDPA/HSUPA Measurement Application (N9073A-2FP)

High speed packet access (HSPA) signals can be analyzed using the HSDPA/HSUPA measurement application. On HSDPA signals, 16-QAM HS-PDSCH is automatically detected for code domain and modulation accuracy measurements. On HSUPA signals, channels like E-DPCCH and E-DPDCH in SF2 can be demodulated. Adaptive Modulation and Coding (AMC) is supported, as well as Discontinuous Transmission (DTX). The HSDPA/HSUPA measurement application requires WCDMA application (N9073A-1FP).



802.16 OFDMA Measurement Application (N9075A)

The Agilent N9075A 802.16 OFDMA measurement application provides one-button standard-based pass/fail testing of IEEE 802.16-2005 (Mobile WiMAX) compliant signals. It offers automatic zone map decoding, SCPI programmability, familiar front panel local operation, and superior measurement speed. Power, spectrum, and modulation measurements such as RCE, spectral flatness, and SEM are included, all with adjustable pass/fail limit indicators.



89601A Vector Signal Analysis Software

For more information please refer to page 124.

Additional Measurement Applications

The following additional measurement applications will be available for order beginning on December 1, 2007.

Analog demodulation measurement application (N9063A)
 Noise figure measurement application (N9069A)
 GSM/EDGE measurement application (N9071A)
 TD-SCDMA measurement application (N9079A-1FP)
 HSDPA / 8PSK measurement application (N9079A-2FP)
 89601X VSA application
 1xEV-DO measurement application (N9076A)*
 cdma2000/cdmaOne measurement application (N9072A)

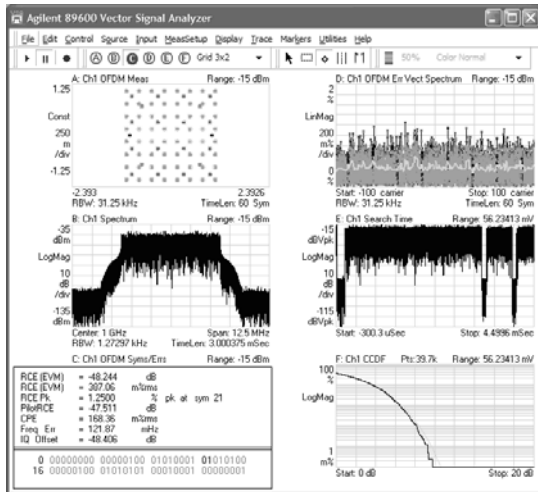
Consult the Agilent website for the latest listing of available measurement applications for both EXA and MXA:

www.agilent.com/find/exa_apps
www.agilent.com/find/mxa_apps

* available for order mid-2008

89601A/
89601AN/
89601N12
Vector
Signal
Analysis
Software

- Flexible modulation analysis and troubleshooting tools
- Powerful 3GPP/WLAN/802.16 analysis options
- Advanced analysis tools for wideband satellite and radar signals
- Multi-channel ready
- PC-based, ESA/PSA/MXA/EXA/Scope/Logic Analyzer compatible



The Agilent 89600 series vector signal analysis software characterizes complex modulated, time varying signals with detailed and simultaneous spectrum, modulation and time waveform analysis tools. Use these tools to uncover signal anomalies you couldn't see before.

Measurements include: time, gated time, spectrum, power spectral density, CCDF and CDF, auto-correlation and more. These tools help you easily troubleshoot pulsed and hopping signals.

The 89600 VSA software offers markers which display current location, calculate offset (delta) values, provide frequency counter capability, integrate between two lines to determine bandpower, calculate occupied bandwidth (OBW), let you set up zones to calculate adjacent channel power (ACPR), and conduct limit tests. Markers can be coupled across displays (up to six simultaneously), allowing you to "walk" through your signal and see its behavior in multiple domains — a very powerful and useful feature.

Characterize intentionally and unintentionally-modulated AM/PM/FM signals in both the frequency and time domains. Check phase, amplitude and frequency trajectories of pulsed signals, make phase noise measurements, uncover interference and more.

The 89600 VSA software lets you capture your digitized signal in your measurement hardware. Then, link it to a supported Agilent signal generator for signal stimulus. Record the signal at one frequency, and using the zoom mode feature, transfer the signal to the generator at a different frequency. Control key features of the signal generator from the 89600 VSA software front panel.

The 89600 VSA software comes fully equipped to control and process two base band or two RF channels. Powerful and sophisticated trace data provide you with the basic capabilities to perform MIMO-analysis. Use these tools to develop and analyze complex multi-antenna, radar, or signal surveillance systems. Check hardware specifications to determine which hardware platform configurations support multiple channels (literature #5989-1753EN.)

Take advantage of Agilent's flexible licensing capability for the 89600 VSA software. A software license is the key that unlocks the powerful measurement capability of the 89600 software on your PC. Floating (89601AN), node-locked (89601A), and limited term (89601N12) licenses are available, depending on your need.

View constellation diagrams, make I/Q quality measurements (imbalance, quadrature error, offset) and more. The Agilent 89600 VSA software offers sophisticated error analysis that lets you see both RF and DSP problems. The key is the EVM measurement. EVM compares the phase and magnitude of the input signal with an ideal reference signal stream. The average error over time is displayed as

a single percent, or the error can be viewed on a symbol-by-symbol basis. Use the FFT of the EVM error signal to identify systematic impairments you couldn't otherwise see. Identify spurs coupling from other parts of the system by looking at the EVM spectrum for peaks.

Powerful Modulation Analysis Options

Flexible Modulation Analysis (Option AYA)

Option AYA demodulates a wide range of standard communication formats, such as EDGE and GSM. But it also offers a wide range of general purpose demodulators for FSK, BPSK, QPSK, offset QPSK, QAM, and VSB, all with user-settable symbol clock rate, bandwidth, filter type and alpha. You can even apply your own proprietary filtering by providing the filter's impulse or frequency response.

3G Modulation Analysis (Option B7N)

Evaluate and troubleshoot your 3G modulated wireless communications signals with Option B7N. Whether your signal is cdma2000 or W-CDMA, TD-SCDMA or 1xEV-DO, HSDPA or 1xEV-DV, the tools and analysis flexibility in Option B7N help you test your signal to its standard and troubleshoot the problem if the signal fails to meet its standard. You can purchase the modulation types separately as option B7T (cdma2000/1xEV-DV), option B7U (WCDMA/HSDPA), option B7X (TD-SCDMA), or option B7W (1xEVDO).

WLAN Modulation Analysis (Option B7R)

Agilent is an industry leader in WLAN signal analysis. The WLAN analysis option available with the 89600 VSA software offers:

- 802.11a OFDM modulation analysis
- 802.11b DSSS/CCK/PBCC modulation analysis
- 802.11g modulation analysis
- 802.11a/b/g standards-based testing

IEEE 802.11n MIMO Modulation Analysis (Option B7Z)

Analyzing an IEEE 802.11n MIMO signal is extraordinarily challenging because it is made up of multiple OFDM signals that transmit on the same frequency at the same time. The advanced troubleshooting and evaluation tool set provided by Agilent's IEEE 802.11n MIMO modulation analysis option is specifically designed to handle this challenge and more.

IEEE 802.16-2004 OFDM Analysis (Option B7S)

Analyzing OFDM signals requires developers to think in the time and frequency domains simultaneously. You need OFDM-specific signal analysis tools to help you manipulate and break down the signal in order to effectively troubleshoot the situation. The IEEE 802.16 OFDM analysis software helps you do this quickly and efficiently.

Option B7S provides comprehensive coverage of the IEEE 802.16-2004 standard:

- All IEEE 802.16-2004 modulation formats, including BPSK, QPSK, 16QAM, and 64QAM
- TDD, FDD, and H-FDD
- Uplink and downlink
- Burst and continuous
- All frame lengths, guard intervals, and sampling factors
- Demodulation down to the raw bit level

MB-OFDM ultra-wideband modulation analysis (Option BHB)

Troubleshoot your WiMedia-based multi-band OFDM ultra-wideband PHY layer signals, such as those in certified wireless USB, with the industry's most complete set of easy-to-use measurement tools, providing you with an unparalleled view into your PHY layer signals. Use Option BHB running on the high performance Agilent DSO80000 Series oscilloscopes to help you identify the root causes of problems, sooner.

RFID Modulation Analysis (Option BHC)

Use the powerful measurements and displays of the 89600 software to troubleshoot RFID systems. Analyze both the forward (interrogator) and return (tag) signals. Use the built-in pre-sets for some of the RFID standards or manually set the demodulation format, line coding, and bit rate or tari.

IEEE 802.16e OFDMA Analysis (Option B7Y)

Analyze your IEEE 802.16e OFDMA signal with the advanced troubleshooting tools offered in option B7Y. Evaluate modulation performance by logical sub-channel, by burst and by zone. Analyze uplink and downlink burst formats, TDD and FDD and more.

Connectivity

Add world-class modulation analysis to your Agilent spectrum analyzer, oscilloscope, and more. Link the 89600 VSA software to any one of a variety of Agilent instruments to sample your signal. Connection to the instruments is via GPIB, FireWire® (IEEE-1394), USB or LAN. The software supports the following platforms.

ESA-E Series Spectrum Analyzers

The ESA-E Series general-purpose, portable spectrum analyzers offer a wide range of performance, features, and flexibility with up to 26.5 GHz tuning range and 10 MHz of analysis bandwidth. Measurement control is via GPIB LAN/GPIB gateway, USB/GPIB gateway.

PSA Series High-Performance Spectrum Analyzers

The Agilent PSA Series offers high performance spectrum analysis up to 50 GHz with powerful one-button measurements, a versatile feature set, a leading-edge combination of flexibility, speed, accuracy, dynamic range, and up to 80 MHz of analysis bandwidth. Measurement control is via LAN or GPIB.

MXA Series Mid-Performance Spectrum Analyzers

The MXA signal analyzer takes signal and spectrum analysis to the next generation, offering the highest performance in a midrange signal analyzer with the industry's fastest signal and spectrum analysis, eliminating the compromise between speed and performance. With a broad set of applications and demodulation capabilities, an intuitive user interface, outstanding connectivity and powerful one-button measurements, the MXA is ideal for both R&D and manufacturing engineers working on cellular, emerging wireless communications, general purpose, aerospace and defense applications. The software can run in the MXA or on an external PC.

Infiniium Scopes

Combine the 89600 VSA software with Agilent's Infiniium oscilloscopes (many models) to analyze super wide bandwidth signals. The oscilloscopes provide up to 13 GHz of analysis bandwidth and are well suited to digitizing down-converted satellite, LMDS, and MMDS signals. The software can run in the scope (many models) or on an external PC.

Logic Analyzers

Analyze your digital baseband and zero IF signals without having to convert them to analog signals first. Monitor the results of FPGA and ASIC-based DSP algorithms directly. Use the Agilent 16900 or 1680/1690 series logic analyzers to connect to and capture the data and the 89600 VSA software to evaluate and troubleshoot the performance of the vector modulation the data represents. View the constellation, measure I/Q parameters, see EVM behavior over time and frequency, and more directly in the logic analyzer or via connection to an external PC.

Modular VXI Analysis Hardware

Used as part of Agilent's 89600S Series vector signal analyzer family, this versatile combination of modules offers 36 MHz of analysis bandwidth, up to 6 GHz tuning range in a compact 4-slot VXI main-frame and coherent 2-channel MIMO analysis. Measurement control is via FireWire.

Two Channel Operation

For use when you need cross channel or I + jQ results, the software supports two channel configurations based on the VXI modular hardware and Agilent Infiniium or 6000 Series multi-channel scope models. 2-channel operation is also supported with the PSA Series spectrum analyzers for use with the 89604A/N distortion test suite application.

Agilent Connected Solutions (Option 105)

The powerful, PC-based 89600 VSA software offers tight, interactive integration with Agilent EEsof's Advanced Design System to analyze computational data from a simulation. Dynamically link the 89600 software to any point in the digital model to analyze data by simply dragging the VSA icon to the desired spot in the schematic.

Link to The MathWorks Simulink Model-Based Design Software (Option 106)

Gain the power of the 89600 VSA measurements and displays for Simulink-based designs with Option 106. This option provides a VSA block set designed to work with Simulink tool sets and block sets. Use the VSA sink to accept data from the simulation, then process and display it using the wealth of features and functionality in the 89600 VSA software. The VSA source allows you to accept measured data from Agilent test equipment, and feed it into the Simulink design.

Key Literature & Web Link

89600 Demonstration Software CD, p/n 5980-1989E
 89600 Software Technical Overview, p/n 5989-1679EN
 89600 Software Data Sheet, p/n 5989-1786EN
 Using Infiniium Scopes with 89600 SW, p/n 5988-4096EN
 Making Digital Baseband Measurements with Logic Analyzers and the 89600 SW, p/n 5989-2384EN
 Making WiMAX Measurements with 89600 SW, p/n 5989-2029
 89600 Measurement Platforms Data Sheet, p/n 5989-1753EN
 89650S Wideband VSA Technical Overview, p/n 5989-0871EN
 89604A/AN Distortion Test Suite Technical Overview, p/n 5988-7812EN
 89607A WLAN Test Suite Technical Overview, p/n 5988-9574EN

See www.agilent.com/find/89600 for more information

Ordering Information

89601A/AN VSA software

- 200 Basic Vector Signal Analysis
- 300 Hardware Connectivity
- 105 ADS Connectivity
- 106 Simulink Connectivity
- AYA Flexible Modulation Analysis
- B7R WLAN Modulation Analysis (802.11a/b/g)
- B7Z 802.11n MIMO Modulation Analysis
- B7S IEEE 802.16-2004 OFDM Modulation Analysis
- B7Y IEEE 802.16 OFDMA Modulation Analysis
- B7T cdma2000/1xEV-DV Modulation Analysis
- B7U W-CDMA/HSDPA Modulation Analysis
- B7W 1xEV-DO Modulation Analysis
- B7X TD-SCDMA Modulation Analysis
- B7N 3GPP Analysis Bundle (includes B7T, B7U, B7W, B7X)
- BHA TEDS Modulation and Test
- BHB MB-OFDM Ultra-wideband Modulation Analysis
- BHC RFID Modulation Analysis

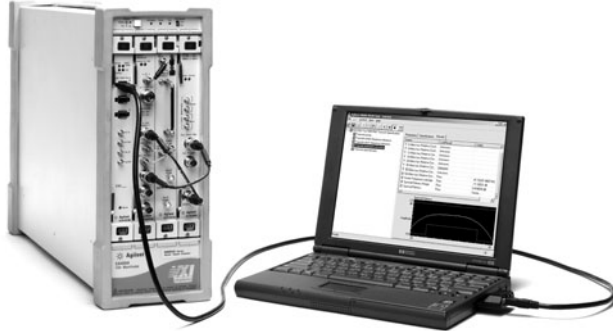
89601N12 VSA Software, 12 Month License

89601AS Additional Software Update Subscription Service, (node-locked license)

89601ASN Software Update Subscription Service for 1 Server (floating license)

89601A/
 89601AN/
 89601N12
 Vector
 Signal
 Analysis
 Software

- Frequency range: DC to 6 GHz
- At least 36 MHz analysis bandwidth
- Baseband I&Q inputs available
- Flexible digital demodulators with settable center frequency, symbol rate, filter type and alpha/BT
- Standards based measurement setups include GSM (EDGE), cdma2000, W-CDMA, PHP, 1xEV-DO, TD-SCDMA, 802.11a/b/g (WLAN), 802.16 OFDM and OFDMA and more
- Up to 1.2 GB of signal capture and playback memory
- PC-based analysis software also works with PSA/ESA spectrum analyzers, many Infiniium scopes, logic analyzers, Agilent's Advanced Design System (ADS)



89640S 2.7 GHz VXI-based VSA.

89600S VXI-based Vector Signal Analyzers

The Agilent 89600S family of VXI-based vector signal analyzers measures the RF and modulation quality of wideband modulated signals. They offer FFT based spectrum analysis, wideband flexible demodulation, and scope-like measurements on RF signals.

Along with wide IF bandwidths (36 to 39 MHz), the 89600S VSAs offer traditional RF spectrum displays, baseband (I/Q) analysis, signal capture memory, RF and IF triggering, a wide variety of analog and digital demodulators, and an extensive set of time, frequency and modulation analysis tools. These capabilities make 89600S VSAs ideal for evaluating narrowband and wideband signals.

Analyze a wide variety of standard and non-standard signal formats using the popular 89600 vector signal analysis software. Standard-signal presets cover GSM, GSM (EDGE), CDMAOne, cdma2000/1xEV-DV, W-CDMA/HSDPA, 802.11a/b/g, 1xEV-DO, TD-SCDMA, 802.16-2004 and more. For emerging standards, the 89600 analyzers offer numerous digital demodulators with variable center frequency, symbol rate, filter type and alpha/BT. A user-adjustable adaptive equalizer is also provided.

89610S Baseband Vector Signal Analyzer

Targeted at baseband measurements this is a DC-40MHz VSA with 39 MHz bandwidth. A second channel can be added giving I and Q baseband measurements and 78 MHz effective bandwidth for I+jQ measurements.

89611S IF Vector Signal Analyzer

Designed to team with tuners having 70 MHz IF center frequencies this is a 52 – 88 MHz VSA with 36 MHz analysis bandwidth. A second channel can be added for baseband I&Q analysis.

89640S RF Vector Signal Analyzer

The versatile 89640S is designed to measure the RF and modulation quality of signals up to 2.7 GHz. Baseband I and Q inputs are available. Coherent 2-channel RF measurements up to 2.7 GHz are available for MIMO analysis.

89641S RF Vector Signal Analyzer

This flexible modular system is designed to measure signals up to 6.0 GHz. Baseband I and Q inputs are available. Coherent 2-channel RF measurements up to 2.7 GHz are available for MIMO analysis.

89600 Series Vector Signal Analysis Software

The 89600 Series vector signal analysis software is a PC based package designed to measure the RF and modulation quality of most digitally modulated signals. Its large array of demodulators, filters, displays, and analysis tools make it ideally suited to evaluating and troubleshooting modulated signals in the R&D lab and can be directly linked to a wide range of Agilent spectrum analyzers, digital oscilloscopes and modular VXI systems. This software is provided as part of the 89610S, 89611S, 89640S and 89641S vector signal analyzers.

Choose either node-locked (89601A), floating (89601AN), or limited-term (89601N12) licensed software. One year of software update subscription service is included with the node-locked license.

89604A Distortion Test Suite Software

The 89604A distortion test suite software accurately measures AM/AM and AM/PM distortion. The wideband product is compatible with complex modulated stimulus signals with bandwidths as high as 36 MHz. This wideband measurement technique helps assure that even subtle distortion mechanisms like memory effects and local heating are stimulated and measured. Use the complete graphic and data summary tables to characterize the performance of your MCPA.

Specifications

	89610S	89611S	89640S	89641S
Frequency Range	DC to 40 MHz	52 to 88 MHz (or frequency range of external tuner)	DC to 2700 MHz	DC to 6000 MHz
Maximum Analysis Bandwidth	39 MHz	36 MHz	36 MHz	36 MHz
Sensitivity Displayed Average Noise Level at 1 GHz at Max Frequency	<-151 dBm/Hz	<-159 dBm/Hz	<-158 dBm/Hz <-156 dBm/Hz	<-157 dBm/Hz <-153 dBm/Hz
Dynamic Range (3rd IMD)	<-70 dBc ¹	<-70 dBc ¹	<-70 dBc ¹	<-70 dBc ¹
Amplitude Accuracy (20-30°C)	±0.8 dB	±0.8 dB	±2.0 dB	±2.0 dB
Signal Capture Memory	Up to 1.2 GB (384 MSa, complex)			
I&O Inputs	Option	Option	Option	Option
2 RF Channel Support			✓	✓

¹ tones @ 6 dB below full scale (-31 dBm at input)

Key Literature & Web Link

89600 Demonstration Software CD, p/n 5980-1989E
 89600 VXI Configuration Guide, p/n 5968-9350E
 89600 Software Technical Overview, p/n 5989-1679EN
 89600 Software Data Sheet, p/n 5989-1786EN
 89600 Measurement Platforms Data Sheet, p/n 5989-1753EN
 89650S Wideband VSA Technical Overview, p/n 5989-0871EN
 89650S Wideband VSA Configuration Guide, p/n 5989-1435EN
 89607A WLAN Test Suite Technical Overview, p/n 5988-9574EN
 89604A Distortion Test Suite Technical Overview, p/n 5988-7812EN

See www.agilent.com/find/89600 for more information

Ordering Information

89600S Vector Signal Analyzer**89610S/89611S/89640S/89641S**

144 MB/288 MB/1.2 GB signal capture memory option
 Add a second IF/baseband channel option
 Add a second RF channel option (89640/41 only)
 Choice of VXI-mainframe size: 4, 6, 13-slot (not all configurations fit all units)
 Choice of PC interface: desktop, laptop; also, laptop PC with software installed

89600 Series VSA Software

Choice of node-locked (89601A), floating (89601AN) or limited-term license (89601N12)
 (Basic VSA and Hardware Connectivity options included)
 Flexible vector modulation analysis option
 3G modulation analysis options
 WLAN modulation analysis option
 IEEE 802.16 OFDM WiMAX modulation analysis option
 IEEE 802.16e OFDMA modulation analysis option
 Dynamic Link to ADS

Also Available

89604A/AN Distortion Test Suite
89607A WLAN Test Suite
89601AS Software Update Subscription Service (node-locked license)
89601ASN Software Update Subscription Service (floating license)

89610S
 89611S
 89640S
 89641S

E4411B
E4403B
E4408B
E4402B
E4404B
E4405B
E4407B

ESA Series
Spectrum
Analyzers

- **±1.0 dB amplitude accuracy**
- **5 minute warm up to guaranteed performance**
- **Wide set of built-in power measurements**
- **Integrated measurements for noise figure and phase noise (opt)**
- **RMS, quasi-peak, peak detectors and EMI bandwidths are available**
- **Built-in help**



3

ESA Series Spectrum Analyzers

ESA Express Analyzers Provide Ordering Ease, Fast Delivery, and Best Value

The ESA analyzer is available in three “express option” choices. Express Analyzer options are based on the most frequently ordered ESA configurations and most popular options. The express analyzer options simplify the ordering process while maintaining the flexibility of the ESA platform. Just select the ESA express analyzer that meets your needs and budget. Express analyzers are favorably priced and provide faster delivery. For unique requirements, the ESA analyzer may be custom configured from the complete set of available options.

ESA Basic Analyzer (Option BAS or BTG)

For basic, quality, spectrum analysis on RF or microwave signals at an affordable price. The basic analyzer provides general spectrum analysis with the speed, accuracy and dynamic range to give you confidence in your measurement results.

- 1.5 GHz, 3.0 GHz, and 26.5 GHz Frequency range
- 1.1 dB overall amplitude accuracy
- 100 Hz RBW (optional)
- +7.5 dBm TOI
- 5 minute warm-up to guaranteed measurement accuracy
- Rugged design, weather resistant, snap on battery pack
- Multifunction power measurement suite

ESA Standard Analyzer (Option STD or STG)

The standard analyzer includes a wide set of built-in functions and features while maintaining the flexibility to add the most popular ESA options.

- 0.4 dB amplitude accuracy (95% confidence level)
- 10 Hz RBW (1 Hz with option)
- +16 dBm TOI
- FM demodulation
- Expandable platform

ESA Communication Test Analyzer (Option COM)

Expand on the leading performance and functionality of the standard analyzer with the addition of built-in demodulation hardware. When combined with the communication focused measurement personalities or the Agilent 89601 VSA software, this express analyzer makes a powerful tool for communications device development.

- 0.4 dB amplitude accuracy (95% confidence level)
- 1 Hz RBW
- +16 dBm TOI
- Precision frequency reference
- 10 MHz demodulation bandwidth
- Optional communications focused applications such as flexible modulation analysis, GSM/EDGE, and cdmaOne
- Link to the popular Agilent 89601A vector signal analysis software for fully flexible demodulation analysis and in depth trouble shooting tools

Performance

Amplitude Accuracy

The ESA offers performance in accuracy with a guaranteed overall amplitude accuracy of less than 1.0 dB error (<3 GHz) based on traceable and warranted specifications. Other economy-class analyzers may specify only typical performance levels. The ESA excels in overall amplitude accuracy whether comparing guaranteed specifications or expected levels of performance.

Frequency Accuracy

The ESA provides a warranted internal frequency reference that may not be available in other economy-class analyzers. Further, the ESA has excellent frequency readout accuracy, a function of the frequency reference error as well as the span error coefficient, RBW, center frequency, and number of sweep points.

Measuring Low Level Signals such as Spurs

The ESA offers top performance thanks to its optional built in low noise, high gain preamplifier. Achieving a Displayed Average Noise Level (DANL) of better than -167 dBm.

Measuring Lower Level Signals Next to Higher Power Signals

A spectrum analyzer's dynamic range is a function of both its displayed average noise level (DANL) performance and its intermodulation distortion performance. The ESA third order intermodulation distortion performance is +16 dBm third order intercept (TOI) (+7.5 for basic analyzer configurations). In addition, the ESA features a standard 5 dB step attenuator making it easy to optimize the spectrum analyzer's mixer level settings to achieve the best dynamic range.

5 Minute Warm Up Time

Most spectrum analyzers take 15 minutes to 1 hour to warm up before the specifications in the data sheet are valid. Not with the ESA. The ESA takes only 5 minutes to warm-up so technicians and engineers spend little time waiting for instrument stabilization.

Automatic Background Alignment

The automatic, internal background alignment feature gives consistently accurate results over varying temperatures. This is especially beneficial when operating the ESA outdoors or in varying temperature conditions. Further, the ESA provides guaranteed performance specifications over a wide temperature range of 0 to 55 degrees centigrade.

Wide Selection of Detectors

The ESA has a wide selection of detectors to meet all of your test needs; including averaging (RMS), peak, negative peak, sample, and quasi-peak (optional). Notably, the ESA's RMS averaging detector improves your measurement repeatability and efficiency when testing noise like signals such as today's 2G and 3G formats. In addition the RMS detector provides RMS results as required by several standards. The ESA's optional quasi-peak detector enables you to verify your EMI performance of your DUT, making the ESA a flexible tool for all types of design and verification testing. For a dedicated EMI instrument with established measurement routines and EMI software, the E7400A Series EMC precompliance analyzer may be more appropriate.

Narrow Resolution Bandwidth Filters

Achieve the maximum frequency resolution with the ESA spectrum analyzer's optional narrow resolution bandwidths. The flexibility of the ESA allows you to select the resolution that you need. The base performance of the ESA includes a 1 kHz RBW. Add the narrow resolution bandwidth option (1DR) to get 10 Hz minimum RBW's (100 Hz on the basic analyzer). Or, for the maximum performance, order the high stability timebase option (1D5) in addition to the narrow resolution bandwidth option to get 1 Hz RBW's.

Measurements Made Easy

PowerSuite – Absolute Confidence in Making Power Measurements in 3 Easy Steps

The ESA simplifies the task of making common power measurements through its built-in power measurements. These measurement functions are easy to use.

Step 1

Press the measurement button on the front panel.

Step 2

Select the desired standards-based format or customize your test setup.

The ESA includes a wide selection of standards-based test setups including the following formats:

- cdmaOne (IS-95A/C)
- cdmaOne (J-STD-008)
- NADC
- GSM/GPRS and EDGE
- 3GPP W-CDMA TS 21.141 spurious emissions test
- W-CDMA 3GPP
- cdma2000 SR1
- cdma2000 SR3-MC
- cdma2000 SR3-DS
- PDC
- Bluetooth
- TETRA
- WLAN 802.11a, b, g
- HiperLAN/2
- DVB-T

Step 3

Select the desired measurement functions.

The ESA offers the widest selection of built-in power measurements available in a mid-range instrument:

- Channel power
- Occupied bandwidth
- Adjacent channel power (ACP)
- Multi-carrier ACP
- Power statistics (CCDF) (not available on the basic analyzer)
- Harmonic distortion
- Burst power
- Intermodulation distortion (TOI)
- Spurious emissions
- Spectrum

Agilent's IO Libraries Suite

Agilent's IO Libraries Suite ships with the ESA series spectrum analyzers to help you quickly establish an error-free connection between your PC and instruments – regardless of the vendor. It provides robust instrument control and works with the software development environment you choose. For additional description of Agilent's IO Libraries Suite features and installation requirements, please go to www.agilent.com/find/iosuite/data-sheet

IntuiLink PC Software

With IntuiLink software you can conveniently save and document your results by linking the ESA to MS Word or Excel applications. In addition, the IntuiLink software provides a simple programming interface to the ESA spectrum analyzer allowing you to easily write macros or functions within windows applications to control the ESA spectrum analyzer. IntuiLink is included free of charge with every ESA.

Remotely Control and Monitor the ESA over the Internet

BenchLink web remote control (Option 230) enables you to remotely control your instrument over the internet or intranet. The software operates on a locally-networked computer connected to the ESA by GPIB. The ESA can then be controlled remotely from any client computer on the internet or intranet with a standard web browser.

Segmented Sweep

Segmented sweep allows you to view up to 32 discontinuous segments of the spectrum with varying levels of resolution at the same time. This feature allows you to view problem spots at the same time and save time while doing so by eliminating the need to retune or make long sweeps (standard and communication test analyzers only).

Log Sweep

The log sweep function on the ESA makes it very easy to set up limit lines and view the spectrum in log scale. This is useful for meeting test requirements, such as CISPR, that specify requirements on a log scale (standard and communication test analyzers only).

Amplitude Corrections

Making amplitude corrections for cables, antennas, external mixers or other peripherals used with the ESA is simple using the ESA's built-in amplitude correction tables. Simply populate the ESA's amplitude correction table with correction factors and then turn the corrections on. Up to 4 correction tables may be loaded and applied at any one time. Add correction factors for cables, antennas, or other devices.

E4411B
E4403B
E4408B
E4402B
E4404B
E4405B
E4407B

ESA Series
Spectrum
Analyzers

Application Focused Solutions

Noise Figure

Option 219 (measurement personality) provides one-button noise figure and gain measurements via a user-friendly interface. Smart noise source (SNS) support, DUT setup menus, limit lines with pass/fail functionality, and context sensitive help are just some of the features that simplify noise figure measurements.

Phase Noise

Option 226 (measurement personality) provides a log plot of phase noise in dBc/Hz versus offset frequency. Examine phase noise at a single offset frequency, or make phase jitter measurements utilizing an intuitive user interface.

Modulation Analysis

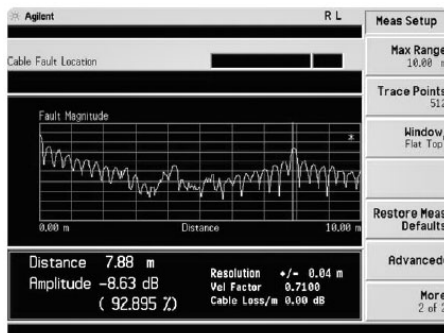
Options 229 (measurement personality) and COM (communication test analyzer) combine to enable you to measure EVM and other related metrics for all major 2G/3G formats. Constellation and eye diagrams are provided to help verify modulation quality.

89601A VSA Link

Option 231 (ESA to 89601A Vector Signal Analysis software link utility) adds vector signal analysis capabilities of the 89601A software to the ESA Communication Test analyzer (Option COM). The 89601A software provides vector signal analysis features such as displaying phase information, time selective frequency domain measurements, time-data displays, spectrogram displays, and more.

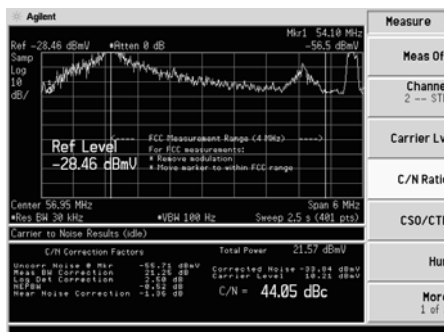
Cable Fault Location

Options 225 (measurement personality), 1DN or STG (tracking generator) and B7K (measurement kit) combine to identify distance to cable discontinuities for fault location and troubleshooting of cable installation and maintenance.



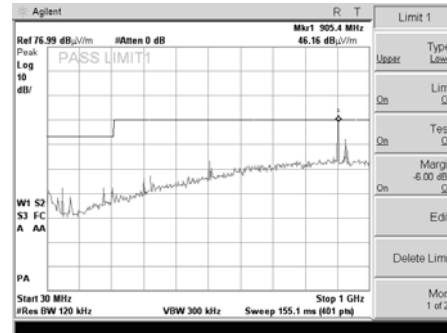
Cable TV Field Service and Analog Broadcast

Option 227 (measurement personality) provides cable TV operators fast, accurate and rugged spectrum analysis for field installation, ingress evaluation and troubleshooting. Perform digital TV measurements by adding Option COM and using the 89601A vector signal analysis software.



Basic EMI Capability

Avoid costly redesign by measuring the radiated and conducted emissions of your design early in the development process. Perform basic EMI measurements by using the ESA's EMI detectors. Additionally, the following EMI bandwidths are available: 200 Hz, 9 kHz, & 120 kHz.



GSM/GPRS/EDGE

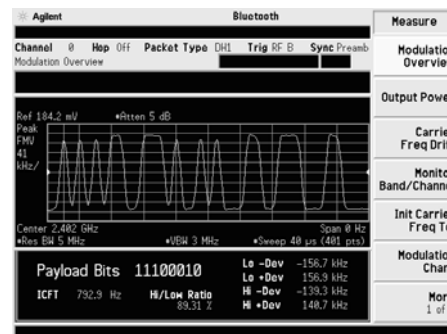
Options BAH and 252 (measurement personalities) and COM (communication test analyzer) combine to provide all the GSM 450/900, DCS1800, PCS1900 tests required to verify the performance of GSM/GPRS/EDGE mobile and BTS transmitters.

cdmaOne

Options BAC (measurement personality) and COM communication test analyzer) combine to make the cdmaOne standard tests that are required to verify the performance of cdmaOne transmitters. Measurements include code domain power, ACPR, Rho, spurious, and more.

Bluetooth™

Option 304 (measurement personality and digital demodulation hardware) provides one-button standards-based Bluetooth transmitter measurements, including modulation characteristics and ACP.



Key Specifications and Features Summary

See the ESA data sheet for more specifications and details. (<http://cp.literature.agilent.com/litweb/pdf/5968-3386E.pdf>)

0.4 dB Overall Amplitude Accuracy	For maximum measurement confidence based on 95% specification. 1.0 dB accuracy guaranteed.
Guaranteed Frequency Readout Accuracy	Based on internal frequency reference.
Wide Dynamic Range with 16 dBm TOI	(Third order intercept) giving the ESA the widest dynamic range of any analyzer in its class.
–167 dBm DANL with Built-in Pre-amplifier	High-gain, low-noise, fully calibrated pre-amplifier increases sensitivity (optional).
Wide Offset Phase Noise	Performance of –150 dBc Hz at 1 MHz offset (optional).
1-ms RF Sweep Time	Combined with >45 measurements per second, provides virtual real-time updates. Responsive display makes circuit adjustment easier, while increasing the probability of intercepting intermittent signals.
Five-minute Warm-up	Provides full measurement accuracy after just 5 minutes.
Data Transfer (GPIB)	>45 measurements and transfers per second reduces measurement times in ATE environments.
Variable Sweep (trace) Points	Ranging from 101 to 8192, optimizes measurements for frequency resolution and accuracy versus speed.
Narrow Digital RBW Filters	Adds 1, 3, 10, 30, 100, 200, and 300 Hz resolution bandwidth filters (optional). The 200 Hz bandwidth enables you to perform EMI tests. The 9 kHz and 120 kHz bandwidths come standard.
Time-domain Sweeps	Sweeps 2.5 ns per division in zero span.
Amplitude Correction	Calibrates out frequency-related amplitude effects with built-in amplitude correction factor table. Common EMI correction factors are available for EMC measurements.
Automatic Background Alignment	Continuously calibrates the analyzer. Guarantees accuracy over changing temperatures.
85 to 120 dB Calibrated Display Range	Displays large and small signals simultaneously.
Optional Built-in Tracking Generator	Combines spectrum and scalar test capability in a single instrument. One-button normalize function quickly calibrates the test setup.
5 dB Step Attenuator	Optimizes distortion-free dynamic range.
Wide Selection of Detectors	Including peak, RMS, video averaging, negative peak, sample and optional quasi-peak detector.
Temperature Range	Guaranteed specifications provided over a wide temperature range of 0 to 55°C.

Measurements Made Easy

One-button Power Measurements with Standards-based Setups	Quick setup and measurement time with one-button RF power measurements for all major 2G/3G, WLAN, and digital video formats.
Optimize Reference Level	Button included with the built in power measurements simplifies the setting up of your measurement by automatically adjusting the reference level and attenuator based on signal level.
Segmented Sweep	Saves measurement and setup time by viewing in one sweep only the frequency spans of interest. Paste together up to 32 discontinuous frequency or zero spans in one sweep. Eliminate multiple setups and sweeping through unwanted frequencies.
Log Sweep	Display swept measurements on a logarithmic scale of the frequency domain.
Zoom Windows	Split screen display shows wide spans while zooming in on signals of interest.
Marker Functions	Provides digital resolution of measurement details through peak search, continuous peak search, delta markers, marker table, and carrier-to-noise ratio. Signal track keeps unstable signals centered on the screen while band power calculates total power between user-defined limits.
Frequency Counter	With 1 Hz resolution, minimizes the need for an external frequency counter.
Softkey/Hardkey Interface	Provides a simple user interface while retaining access to sophisticated features.
Built-in Help Button	Eliminates carrying manuals into the field to determine softkey/hardkey functions and remote SCPI commands.
Limit Lines	Built-in limit lines and pass/fail messages simplify testing. EMI limit lines are available.
Built-in Clock/Calendar	Provides time stamps on both stored and printed data.
Automatic Overload Protection	Protects RF input from overly large signals (E4411B).
Automatic Printer Setup	Identifies connected most Hewlett-Packard printer models automatically.
IntuiLink Software	PC software provides easy transfer of measurement results into Microsoft® Excel and Microsoft Word. Download from www.agilent.com/find/intuilink
SCPI Programming Interface	Allows full remote control and programming of the ESA spectrum analyzer.
IVI COM Drivers	Provides interface for programming in many environments, including Visual Studio®, LabVIEW®, and Agilent VEE. Drivers may be found at: www.agilent.com/find/drivers

E4411B

E4403B

E4408B

E4402B

E4404B

E4405B

E4407B

ESA Series
Spectrum
Analyzers

Instrument Design, Express Analyzer Features and Performance Summary

Large, Color VGA Display with Output	16.8 cm, high-resolution color display makes detailed observations easy. Includes 15-pin color VGA rear output connector for external color monitor.
Fully Synthesized Design	Provides continuously phase-locked precision throughout the entire sweep. Assures frequency accuracy, stability, and measurement repeatability, eliminating drift.
Snap-on Battery	Eliminates the restrictions of power cords.
Rubber-encased Front and Rear Frames	Provides impact protection in the field.
Rain-resistant Front Panel	Combined with louvered air vents, allows operation in diverse weather conditions.
12 Vdc Power Cable	Allows direct operation from automotive and truck batteries.
Parallel Port	Supports output to the most popular Hewlett-Packard printers.
Floppy Disk Drive	Move measurement results files to your PC quick and easy.
8.0 MB Data Storage	Provides internal storage of measurement data and setups for future analysis or comparison.

Express Analyzer Features and Performance Summary

See the ESA data sheet for more specifications and details. (<http://cp.literature.agilent.com/litweb/pdf/5968-3386E.pdf>)

	Basic Analyzer (Option BAS/BTG)	Standard Analyzer (Option STD/STG)	Communication Test Analyzer (Option COM)	ESA Optional Performance with Custom Configuration
Frequency Range	9 kHz to 1.5, 3.0, 26.5 GHz	9 kHz to 3.0, 6.7, 13.2, 26.5 GHz	9 kHz to 3.0, 6.7, 13.2, 26.5 GHz	30 Hz to 3.0, 6.7, 13.2, 26.5 GHz (Option UKB)
Speed				
Sweep Time (<3 GHz)	4 ms to 4000 s	1 ms to 4000 s	1 ms to 4000 s	1 ms to 4000 s (Option 1D5)
Zero Span Sweep	4 ms to 4000 s	50 ns to 4000 s	25 ns to 4000 s	25 ns to 4000 s (Option B7D/B7E)
Remote Trace Transfer	30/sec	45/sec	45/sec	45/sec
Warm Up Time	5 mins	5 mins	5 mins	5 mins
Dynamic Range				
Resolution Bandwidth	100 Hz to 5 MHz with Option	10 Hz to 5 MHz 1Hz with Option 1D5/1DR	1 Hz to 5 MHz	1 Hz to 5 MHz (Option 1DR and 1D5)
Phase Noise 10 kHz	-93 dBc/Hz + 20 LogN	-101 dBc/Hz ¹ + 20 LogN	-101 dBc/Hz ¹ + 20 LogN	-101 dBc/Hz ¹ + 20 LogN (Option 120)
Measurement Range (Option 1DR)	-130 dBm to +30 dBm	-140 dBm ² to +30 dBm -156 dBm ² with Option 1DS	-150 dBm to +30 dBm -167 dBm with Option 1DS	-167 dBm to +30 dBm (Options 1DR, 1D5, 1DS)
T0I (for Spurious Free Dynamic Range (SFDR))	+7.5 dBm	+16 dBm	+16 dBm	+16 dBm
Accuracy				
Frequency Accuracy	±101 Hz	±101 Hz	±101 Hz	±101 Hz
Span Accuracy	±0.5%	±0.5%	±0.5%	±0.5%
Amplitude Accuracy	±1.1 dB	±0.4 dB	±0.4 dB	±0.4 dB
Measurement Capability				
Sample of Available Features	PowerSuite one button measurements, IntuiLink connectivity to MS Office, amplitude corrections	Basic features plus: log sweep, segmented sweep, optional preamp, CCDF function, FM demodulation, variable sweep points	Basic and standard features plus: digital demodulation capability	Basic, standard, and communication test features plus: 75 ohm (1DP), quasi-peak detection (AYQ), external mixing (AYZ), Class B emissions (060), and wide offset phase noise (120)
Available Measurement Applications	Cable TV	Noise figure, phase noise, cable fault, cable TV	Flexible demodulation with 89601A software, modulation analysis, GSM/EDGE, cdmaOne, noise figure, phase noise	Basic, standard, and communication test applications plus Bluetooth (304)
Future Upgrades	Limited	Available	Available	Available

¹ With Options 1DS and 1DR.

² Enhanced performance is available with different option configurations. Up to -167 dBm performance is available with Options 1DR, 1D5, and 1DS.

Ordering Information – Custom Configurations

Equivalent Options and Bundles

Option	Equivalent Option(s)	Comments
ESA-L Series		
BAS – Basic analyzer	A4J	Order BAS or BTG to get best delivery and price
BTG – Basic analyzer with TG	A4J, 1DN	Order BAS or BTG to get best delivery and price
ESA-E Series		
STD – Standard analyzer	AYX, BAA	Order STD, STG, or COM to get best delivery and price
STG – Standard analyzer with TG	AYX, BAA, 1DN	Order STD, STG, or COM to get best delivery and price
COM – Communication test analyzer	B7D, B7E, 1D5, 1DR, BAA, 231	Order STD, STG, or COM to get best delivery and price
B75 – Performance bundle	1DR, 1DS, 1D5	Only available on the Standard Analyzers (Express Option STD or STG)
304 – Bluetooth premium bundle	228, 106, B7D, B7E, 1DS, 1D5	Options 106 and 228 are not available outside of the Option 304 bundle

E4411B
E4403B
E4408B
E4402B
E4404B
E4405B
E4407B

ESA Series
Spectrum
Analyzers

ESA-L Series Custom Analyzer

All custom ESA-L series include a 75 Ω input port

Available Models		
E4411B (9 kHz to 1.5 GHz)		Custom configuration not available for E4403B or E4408B
Included Options		
GPIB connection	A4H	Standard on every instrument unless 1AX is ordered; Occupies 1 expansion slot
IntuiLink PC connectivity software	Included	Connects to Microsoft® Word and Excel; download for free from www.agilent.com/find/intuilink
Available Options		
75 ohm impedance	1DP	
Replace GPIB connection (A4H) with serial port	1AX	Not compatible with Option A4H; Occupies 1 expansion slot
IF sweep, and video output ports	A4J	Occupies 1 expansion slot
Narrow resolution bandwidths	1DR	100 Hz minimum on ESA-L Series
75 ohm tracking generator (1 MHz to 1.5 GHz)	1DQ	Requires Option 1DP
8590-Series programming code compatibility	290	Free download from www.agilent.com/find/esa ; no license required
Future Upgrades		
Limited upgrades are available		For more details about upgrades, go to: www.agilent.com/find/saupgrades

3

Key Literature & Web Link for ESA

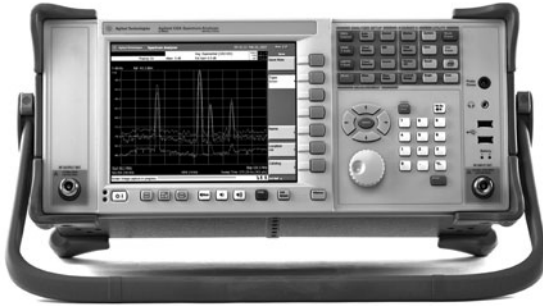
Agilent ESA Series Spectrum Analyzer Data Sheet, p/n 5968-3386E
 Agilent ESA/EMC Spectrum Analyzer Configuration Guide, p/n 5968-3412E
 Agilent ESA Series Spectrum Analyzer Brochure, p/n 5968-3278E

www.agilent.com/find/esa

ESA Accessories

Option	Description	Comments
Accessory information can be found at: www.agilent.com/find/sa-accessories		
ESA Specific Accessories		
A5D	12 VDC power cable	DC power connection available on every ESA
AXT	Hard transit case	
AYT	Gray soft carrying/operation case	
AYU	Yellow soft carrying/operation case	
B7K	Cable fault measurement kit (50 ohm)	Requires Option 1DN or STG, and Option 225 or BAH
042	Gray backpack carrying case	
044	Yellow backpack carrying case	
1CP	Rack mount kit with handles	
1D7	50 to 75 ohm minimum loss pad	
E1779A	Rechargeable snap-on battery and charger	Order as separate model number, not option number
UK9	Front panel cover	
Software/Firmware		
B70	Benchlink spectrum analyzer, PC software	Also orderable as E4444A; requires A4H or 1AX; Software available from: www.agilent.com/find/benchlinksa
230	Benchlink Web remote control software	Requires Option A4H Software available from: www.agilent.com/find/web_remote
—	IntuiLink software (shipped with every instrument)	Connects to Microsoft® Word and Excel; download for free from www.agilent.com/find/intuilink
UE2	Firmware upgrade	Firmware updates also available on Web site for free download www.agilent.com/find/esa_firmware
Documentation		
OB1	Add extra manual set	Available at www.agilent.com/find/esa_manuals
UK6	Commercial calibration certificate with test data	
OB0	Delete manual set (retains CD-ROM version)	
OBV	Service documentation, component level CLIP	Component level information package
OBW	Service documentation, assembly level	
AB0	Taiwan-Chinese user's guide	Available at www.agilent.com/find/esa_manuals
AB1	Korea-Korean user's guide	Available at www.agilent.com/find/esa_manuals
AB2	China-Chinese user's guide	Available at www.agilent.com/find/esa_manuals
ABD	Germany-German user's guide	Available at www.agilent.com/find/esa_manuals
ABE	Spain-Spanish user's guide	Available at www.agilent.com/find/esa_manuals
ABF	France-French user's guide	Available at www.agilent.com/find/esa_manuals
ABJ	Japan-Japanese user's guide	Available at www.agilent.com/find/esa_manuals
ABZ	Italy-Italian user's guide	Available at www.agilent.com/find/esa_manuals
AKT	Russia-Russian user's guide	Available at www.agilent.com/find/esa_manuals
Warranty, Service, and Calibration		
R-51B-001-C	1 year return-to-Agilent warranty and service	Standard
R-51B-001-3C	3 year return-to-Agilent warranty and service	Default
	Calibration Plan (Industry, Inclusive, and Standard-based plans)	More details at www.agilent.com/find/calibration
General Spectrum Analyzer Accessories		
11970	Harmonic mixer series (26.5, 40, 50, 60, 75, 110 GHz)	For use in E4407B Option AYZ
11974	Preselected millimeter mixer series (40, 50, 60, 75 GHz)	For use in E4407B Option AYZ
11909A	Low noise amplifier to 1 GHz	
8447A/D	Amplifiers to 400 MHz and 1.3 GHz	
8449B	Preamplifier to 26.5 GHz	

- Brightest, highest resolution display in its class
- 1 dB electronic step input attenuator
- RBW, 10 Hz to 5 MHz in 10% steps
- VBW, 1 Hz to 3 MHz in 10% steps, 4, 5, 6, 8 and 50 MHz
- USB and 100 baseT LAN
- Channel power measurements
- Optional spectrogram
- Optional stimulus/response suite with cable fault location
- Optional AM and FM tune and listen
- Optional AM and FM modulation analysis
- Optional preamplifier 3 or 6 GHz



Performance and Quality You Expected at a Price You can Afford

The Agilent CSA spectrum analyzer brings a level of performance not seen previously in a compact spectrum analyzer. The highest dynamic range in its price class is achieved with unmatched distortion performance, substantial noise performance and standard 10 Hz resolution bandwidth. The CSA also offers overall amplitude accuracy of ± 0.5 dB. Now you get all of this capability and more with excellent reliability and low service and support costs.

The user interface is designed to give expert users access to all of the power of the CSA. Logically grouped hard keys, soft keys and menus allow intuitive control of parameters like input attenuator, bandwidth, and detector type. Features such as auto-tune, auto-scale, auto-range, 1 dB step attenuator, built-in preamp and onboard help make the CSA easy to use even for non-experts.

Specifications

Frequency		
Range	100 kHz to 3 GHz/6 GHz	
Internal reference accuracy	$\leq \pm 5$ ppm/year (within two years of adjustment)	
Aging rate	$\leq \pm 2$ ppm/year	
Frequency readout accuracy	$\pm \{ \text{Frequency indication} \times$ frequency reference Accuracy + 1% x span + 10% x RBW + 0.5 x [span/(sweep points - 1)] + 1 Hz}	
Resolution Bandwidth (RBW)		
Zero Span	10 Hz to 200 kHz in 10% steps, 250 kHz, 300 kHz, 1 MHz, 3 MHz, 5 MHz	
	3 kHz to 5 MHz in 1, 3, 5, sequence, 240 kHz and 1.25 MHz	
Video Bandwidth (VBW)		
	1 Hz to 10 Hz in 1 Hz steps, 10 Hz to 3 MHz in 10% steps, 4, 5, 6, 8, and 50 MHz (no filtering)	
Display Average Noise Level (Typ)	Preamp on (10 Hz RBW)	Preamp off
500 MHz	-148 dBm	-130 dBm
1 GHz	-146 dBm	-128 dBm
2 GHz	-142 dBm	-124 dBm
3 GHz	-144 dBm	-130 dBm
4 GHz	-142 dBm	-128 dBm
5 GHz	-139 dBm	-125 dBm
6 GHz	-136 dBm	-122 dBm

Phase Noise (typical)	-85 dBc at 10 kHz offset (0.5 to 2.5 GHz)	N1996A
	-82 dBc at 10 kHz offset (2.5 to 6 GHz)	

Sweep Time and Trace Transfer	
Sweep time setting (zero span)	1 us to 10 s
Remote sweep and trace transfer	
Span = 0	120 ms
Span ≤ 100 MHz	180 ms
Span = 3 GHz	1 sec

Amplitude Accuracy (20 to 30°C)	
Peak detector, preamp off, 95% confidence	± 0.5 dB 10 MHz to 1 GHz ± 0.6 dB 1 GHz to 3 GHz ± 0.8 dB 3 GHz to 6 GHz

Distortion and Residuals	
T0I (Third order intercept)	+18 dBm nominal
SHI (Second order intercept)	+45 dBm (>700 MHz), +30 dBm (<700 MHz)

Input related spurs

Residuals

Preamplifier

Gain

100 kHz to 3 GHz (Option P03)
100 kHz to 6 GHz (Option P06)
22 dB (nominal) <2.7 GHz
18 dB (nominal) <6 GHz

Input/Output

RF input

Signal source output

USB-A

LAN 100 Base-T

Reference out

Reference in

Type N, female (50 Ohms)
Type N, female (50 Ohms)
USB 1.1 (low power device only)
RJ-45 connector
BNC female, 10 MHz, 0 dBm
BNC female, 1 MHz, 2.048 MHz,
4.95 MHz, 10 MHz, 13 MHz,
15 MHz, 19.6608 MHz, 0.5 Hz
(even second clock), -5 to +10 dBm

General Information

Internal data storage

Display

Weight with batteries

Weight without batteries

Dimensions

2 MB for user states and traces
21.3 cm, color, ZGA TFT-LCD
8.5 kg
7.5 kg
17.7 x 42.5 x 23.2 cm
(without bumpers and handle)

Operating temperature

A/C power 0 to 40°C;
battery power 0 to 50°C

Probe Power

+15 V at 150 mA

-12 V at 150 mA

EMI Compatibility

CISPR 11, Class A

Accessories

N1996A-SRK Stimulus/Response Calibration Kit

N1996A-1CM Rack-mount Kit

N1996A-1CP Rack-mount Kit with Handles

N1996A-BAT Battery Pack (2 batteries)

N1996A-BCG External Battery Charger

N1996A-SCC Soft Carrying Case

N1996A-HTC Transit Case (hard cover)

N1996A-ABA Manual Hard Copy (English)

N1996A-ABJ Manual Hard Copy (Japanese)

N1996A-AB2 Manual Hard Copy (Simplified Chinese)

N1996A-0BW Service Documentation

Key Literature and Web Link

CSA Brochure/Data Sheet, p/n 5989-3678EN

Stimulus/Response Measurement Suite, p/n 5989-4602EN

Making a Distance to Fault Measurement, p/n 5989-5209EN

CSA Demonstration Guide, p/n 5989-5159EN

www.agilent.com/find/CSA

Ordering Information

N1996A-503 Base Box 3 GHz

N1996A-506 Base Box 6 GHz

N1996A-P03 Preamplifier 3 GHz

N1996A-P06 Preamplifier 6 GHz

N1996A-AFM AM/FM Tune and Listen

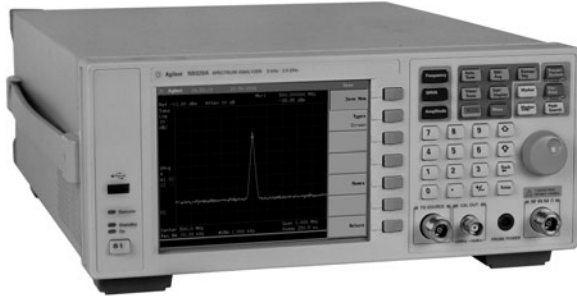
N8995A-SR3 Stimulus/Response Suite to 3 GHz

N8995A-SR6 Stimulus/Response Suite to 6 GHz

N8996A-1FP AM/FM Demodulation Metrics

N9320A

- **Fast sweep: 9.2 ms minimum non-zero span sweep time**
- **Narrow Res BW: 10 Hz to 1 MHz**
- **DANL: -130 dBm, -148 dBm (with preamp on)**
- **TOI: +13 dBm**
- **Auto tune homes in on the highest level of signal across the bandwidth**
- **Power Suite measures RF power easily**



The Agilent N9320A RF spectrum analyzer is one of the new products in Agilent low cost RF instrument family, offering excellent price/performance for customers in consumer electronics manufacturing, bench repair, base station installation and maintenance, and education teaching lab, as well as entry level research and development.

In today's competitive world, you need the measurement to be fast, accurate, and reliable. What is more, you demand a low cost test and measurement solution. Now, Agilent has designed N9320A to fully perform the quality of an Agilent spectrum analyzer to meet your testing needs, and priced the N9320A at an affordable price for you to buy with ease.

As an entry-level spectrum analyzer, Agilent armed N9320A with enhanced usability designs:

- Multi-language user interface helps you to recognize the software menu faster and easier, accelerating front panel operations
- Adequate logical hardkeys and interface, USB connectivity, and SCPI compatible make either front panel operation or remote control easy to start-up

Now, with the exceptional price/performance of the N9320A signal analyzer, you can afford to own the Agilent test equipment you always wanted.

Specifications

Frequency

- Range
 - 9 kHz to 3.0 GHz, AC coupled
 - 100 kHz to 3.0 GHz, Preamp on
- Resolution: 1 Hz

Frequency Readout Accuracy

Marker resolution: (Frequency span)/(number of sweep point - 1)

Frequency Counter

Resolution: 0.1 Hz, 1 Hz, 10 Hz, 100 Hz, 1 kHz, Selectable

Resolution Bandwidth (RBW)

- Range: 10 Hz to 1 MHz, in 1-3-10 sequence, -3 dB bandwidth

Accuracy

- $\pm 20\%$, 1 kHz to 1 MHz RBW
- $\pm 5\%$, 10 Hz to 300 Hz RBW

Video Bandwidth Range: 1 Hz to 3 MHz, in 1-3-10 sequence

Sweep Time

- Range:
 - 9.2 ms to 4000 s, Span > 0 Hz
 - 20 μ s to 4000 s, Span = 0 Hz
- Sweep mode: Continuous, Single

Internal 10 MHz Reference

- Aging rate: ± 1 ppm/year
- Temperature stability: ± 1 ppm
- Supply voltage stability: ± 0.3 ppm

Phase Noise

- Offset from CW signal
 - 10 kHz: < -88 dBc/Hz, typically < -90 dBc/Hz
 - 100 kHz: < -100 dBc/Hz, typically < -102 dBc/Hz
 - 1 MHz: < -110 dBc/Hz, typically < -112 dBc/Hz

Residual FM: ≤ 100 Hz peak to peak in 100 ms, 1 kHz RBW, 1 kHz VBW

Displayed Average Noise Level (DANL):

-130 dBm, -148 dBm with preamp on

Amplitude

- Measurement range: DANL to +30 dBm
- Input attenuator range: 0 to 70 dB, in 1 dB step
- Maximum damage level
 - $\geq +40$ dBm, average continuous power
 - $\geq +50$ dBm, peak pulse power
 - 50 VDC Maximum, DC voltage

Weight: 9.1 kg

Dimensions: 132.5 mm (H) x 320 mm (W) x 400 mm (D)

Warm-up Time: 45 minutes

Key Literature & Web Link

www.agilent.com/find/n9320a

Ordering Information

N9320A RF Spectrum Analyzer

N9320A-PA3 3 GHz Preamplifier

N9320A-TG3 3 GHz Tracking Generator

N9320A-1TC Hard Transit Case

N9320A-1HB Handle and Bumper

N9320A-1CM Rackmount Kit

- Frequency range: 100 kHz to 3 GHz
- RBW: 30 Hz to 1 MHz in 1-3-10 sequence
- VBW: 3 Hz to 1 MHz
- SSB phase noise: -87 dBc at 30 kHz offset
- DANL: (10 MHz $< f_c \leq 1.5$ GHz)
 - 124 dBm
 - 144 dBm with preamplifier on
- Sweep speed
 - 10 ms to 1000s, span ≥ 1 kHz
 - < 120 ms at full span
- Amplitude accuracy: ± 1.5 dB
- 7.2" sunlight-viewable LCD
- > 4 hours battery operating time
- Modern USB connectivity for data transfer and PC control
- 11-language UI
- Tracking generator and preamplifier are options



The Agilent N9340A handheld RF spectrum analyzer provides exceptional performance and optimized usability for installation & maintenance tasks in the field, such as interference test, spectrum monitoring, and on-site repair etc.. N9340A can meet the requirements of users in a variety of industries, including wireless service providers, aerospace & defense, spectrum management authorities and TV & broadcasting industry. N9340A covers the frequency range of 100 kHz (tuneable to 9 kHz) to 3 GHz.

Exceptional Performance

- N9340A provides fast sweep speed. Its sweep speed at full span is less than 120 ms and its non-zero span sweep speed is 10 ms minimum. The fast sweep speed help users locate and identify elusive and transient inference signals. It requires less time to measure across the span and you need not to wait to see the scan. With less field working time required by N9340A, you can improve the productivity
- N9340A provides the best sensitivity in-the-class. N9340A provides the lowest DANL in-the-class: -124 dBm with preamplifier off or -144 dBm with preamplifier on (30 Hz RBW, 10 MHz $< f_c \leq 1.5$ GHz). The optional preamplifier with 20 dB gain further improves analyzer sensitivity. The best sensitivity of N9340A help users detect more low level signal and give them more complete understanding of the spectrum
- N9340A provides the best resolution ability with the narrowest RBW of 30 Hz to 1 MHz in 1-3-10 sequence, making it possible to resolve close-in signals. The narrowest RBW also means least noise is introduced by N9340A for overall lowest DANL
- The Agilent N9340A achieves the lowest SSB phase noise which also helps detect low signals (spurious or noise) close to the carrier which would otherwise be missed

Optimized Usability

- The N9340A provides a 7.2" sunlight-viewable LCD screen which gives you a clear reading of the spectrum scans in the strong sunlight
- The Lithium-ion battery together with the advanced built-in power management provide N9340A an impressive 4 hours operating time. One spare battery or 12 V automotive adaptor can help N9340A operate for an entire day in the field
- N9340A offers USB connectivity for PC control and easy data transfer to USB memory stick. The support for USB memory stick makes data transfer in the field more convenient. The support for PC control via USB interface makes test and measurement more efficient
- N9340A supports 11-language on-screen user interface which allows for easy operation in users' native language. These languages include English, simplified Chinese, traditional Chinese, French, German, Italian, Japanese, Korean, Portuguese, Russian, and Spanish
- N9340A's rugged design makes it tough enough to meet the military customers' requirements. Apart from its compact and rugged construction, the large rubberized grips wrap around both ends provides additional robust protection from rough handling. The sealed keypad and screen are moisture resistant and dust proof

Specifications

Frequency Range

100 kHz (tuneable to 9 kHz) to 3 GHz, AC coupled

Internal 10 MHz Frequency Reference

- Aging Rate: ± 1 ppm/year
- Temperature Stability: ± 2 ppm, 0°C to 30°C ; 30°C to 50°C in addition 2 ppm/ 10°C

Marker Frequency Counter

- Resolution: 1 Hz
 - Accuracy:
 - \pm (marker frequency x frequency reference Uncertainty + Counter resolution)
- RBW/SPAN ≥ 0.02 : Marker level to displayed; Noise level > 25 dB, frequency offset = 0 Hz

Frequency Span

- Range: 0 Hz (zero span), 1 kHz to 3 GHz
- Resolution: 1 Hz

SSB Phase Noise

- 30 kHz: < -87 dBc/Hz
- 100 kHz: < -100 dBc/Hz
- 1 MHz: < -120 dBc/Hz

Resolution Bandwidth (RBW)

- -3 dB bandwidth: 30 Hz to 1 MHz, 1-3-10 sequence
- Accuracy: $\pm 5\%$, nominal
- Resolution filter shape factor: $< 5:1$, nominal; 60 dB/3 dB bandwidth ratio; Digital, approximately Gaussian shape

Video Bandwidth (VBW)

- -3 dB bandwidth, 3 Hz to 1 MHz, 1-3-10 Sequence
- Accuracy: $\pm 5\%$, nominal

Amplitude

- Measurement Range: Displayed average noise level to $+20$ dBm
- Input Attenuator Range: 0 to 51 dB, in 1 dB steps

Maximum Safe Input Level

- Average Continuous Power: $\geq +33$ dBm, 3 minutes max.; Input attenuator setting ≥ 20 dB (Input protection switch active when input level > 33 dBm)
- DC Voltage: 50 VDC max.

N9340A

Displayed Average Noise Level

- Preamp Off
 - 100 kHz < f_c ≤ 1 MHz: < -90 dBm; Reference level ≤ -50 dBm
 - 1 MHz < f_c ≤ 10 MHz: < -110 dBm; Reference level ≤ -50 dBm
 - f_c = 50 MHz: -126 dBm, typical; Reference level ≤ -50 dBm
 - 10 MHz < f_c ≤ 1.5 GHz: < -124 dBm; Reference level ≤ -50 dBm
 - 1.5 GHz < f_c ≤ 3 GHz: < -117 dBm; Reference level ≤ -50 dBm
- Preamp On
 - 100 kHz < f_c ≤ 1 MHz, < -115 dBm, nominal; Reference level ≤ -70 dBm
 - 1 MHz < f_c ≤ 10 MHz, < -128 dBm; Reference level ≤ -70 dBm
 - f_c = 50 MHz, -146 dBm, typical; Reference level ≤ -70 dBm
 - 10 MHz < f_c ≤ 1.5 GHz, < -144 dBm; Reference level ≤ -70 dBm
 - 1.5 GHz < f_c ≤ 3 GHz, < -136 dBm; Reference level ≤ -70 dBm

Reference Level

Setting Range: -100 dBm to +20 dBm, steps of 1 dB

RF Input VSWR (at tuned frequency)

- Attenuator setting 0 dB
 - < 1.8:1, 10 MHz to 3.0 GHz/Nominal
- Attenuator setting 10 dB
 - < 1.8:1, 100 kHz to 10 MHz/Nominal
 - < 1.5:1, 10 MHz to 2.5 GHz/Typical
 - < 1.8:1, 2.5 GHz to 3 GHz/Typical
- Attenuator setting 20 dB
 - < 1.6:1, 100 kHz to 10 MHz/Nominal
 - < 1.4:1, 10 MHz to 3.0 GHz/Typical

Spurious Responses

- Second Harmonic Distortion: < -70 dBc distortion, Mixer level = -40 dBm
- Third Order Intermodulation (TOI): +10 dBm, typical, third-order IM products, 2 x -20 dBm, reference level = -10 dBm, center frequency 300 MHz, frequency Separation = 200 kHz
- Input Related Spurious: < -70 dBc, -40 dBm signal at input mixer, carry offset > 1 MHz
- Inherent Residual Response: < -88 dBm, Input terminated and 0 dB RF attenuation, preamplifier off, reference level -30 dBm, f > 30 MHz, RBW ≤ 10 kHz

Sweep Time

- Range
 - 10 ms – 1000 s, Span > 1 kHz
 - 6 μ s to 200 s, Span = 0 Hz (zero span)
- Sweep Mode: continuous, single
- Trigger Source: free run, video, external
- Trigger Slope: Selectable positive or negative edge

RF Input

- Connector: Type-N female
- Impedance: 50 Ω (nominal)

USB Interface

- Host Connector and Protocol: A plug; Version 1.1
- Device Connector and Protocol: B plug; Version 1.1

10 MHz REF/ External Trigger Input

- Connector: BNC f = Female; 50 Ω
- REF Input Frequency: 10 MHz
- REF Input Amplitude: 0 to +10 dBm
- Trigger Voltage: 5 V TTL level

RF Preamplifier (Option PA3)

- Gain: 20 dB, nominal
- Frequency Range: 1 MHz – 3 GHz

Tracking Generator (Option TG3)

- Connector: Type N, female
- Impedance: 50 Ω , nominal
- Frequency Range: 5 MHz – 3 GHz
- VSWR: < 2.0:1, nominal
- Output Level: 0 dBm to -25 dBm, 1 dB step
- Output Flatness: \pm 3 dB, referenced to 50 MHz, 0 dBm

Calibration Cycle: 1 year**Temperature Range**

- Operating
 - Operating: -10°C to +50°C
 - Battery: 0°C to +50°C
- Storage: -40°C to +70°C
- Battery: -20°C to 50°C
- Warm-up Time: 30 minute

Power Requirements**Temperature Range**

- Voltage: 90 to 120 or 195 to 263 VAC; 47 to 63 Hz; 12 to 18 VDC; < 25 W
- Operating Time (with fully charged battery)
 - 4 h with tracking generator off
 - 3 h with tracking generator on
- Battery Charging Time: 3 h
- Lifetime: 300 to 500 charging cycles
- Power Consumption: 12 W, typical

Display: 7.2" STN transreflective color display**Weight (without options)**

Net: 3 kg (3.5 kg include battery) approximately

Dimensions

318 mm (H) x 207 mm (W) x 69 mm (D) approximately

Key Literature & Web Linkwww.agilent.com/find/n9340a**Ordering Information****N9340 Handheld RF Spectrum Analyzer****N9340A-PA3** 3 GHz Pre-amplifier**N9340A-TG3** 3 GHz Tracking Generator**N9340A-ITC** Hard Transit Case**N9340A-1DC** Automotive 12 V DC Adaptor**N9340A-BAT** Spare Battery Pack

- Preselected mixers to eliminate signal identification
- State-of-the-art technology
- Easier automated measurements
- Low conversion loss
- Individually amplitude calibrated
- No bias or tuning adjustments
- High 100 mW safe input level



11970, 11974 Series Mixers

11974 Series Preselected Millimeter Mixers

Eliminate the need for signal identification at millimeter frequencies. The Agilent 11974 series mixers are preselected from 26.5 to 75 GHz for faster, easier testing of millimeter devices and systems. Preselection reduces mixer overload from broadband signals and reduces radiation of local oscillator harmonics back to the device under test. Equipment operators can quickly locate true signals, and software development for automated measurements is greatly simplified.

These mixers feature advanced barium-ferrite technology and come with a standalone power supply. They are particularly useful for broadband millimeter signal analysis, millimeter electromagnetic interference (EMI) measurements, and unattended monitoring of millimeter signals.

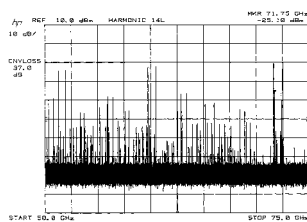
11974 series preselected mixers are available in four bands

Agilent Model	Frequency Range (GHz)	Sensitivity ¹ (displayed avg. noise level/10 Hz) (dBm)	Calibration Accuracy ¹ (dB)	Image Rejection ¹ (dB)	1 dB Gain Compression (dBm)
11974A	26.5 to 40	-111	<±2.3	-54	+6
11974Q	33 to 50	-106	<±2.3	-50	+0
11974U	40 to 60	-109	<±2.6	-50	+0
11974V	50 to 75	-100	<±4.5	-40	+3

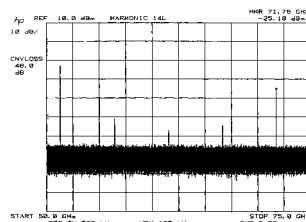
¹Specifications apply when connected to the PSA, 8566B or 70000 series spectrum analyzers.

Compatibility

Upgrade kits are available to assure the compatibility of PSA Series (E4440A/47A/46A/48A) and ESA (E4407B). Consult your Agilent sales representative to determine requirements. All 8560EC series, PSA (E4440A/47A/46A/48A), and ESA (E4407B) spectrum analyzers and the 70907B external mixer interface modules are fully compatible with the 11974 series.



50 to 75 GHz Sweep Without Preselection



50 to 75 GHz Sweep Using 11974 Series Mixer

11970 Series Harmonic Mixers

The 11970 series waveguide mixers are general-purpose harmonic mixers. They employ a dual-diode design to achieve flat-frequency response and low conversion loss. These are achieved without external dc bias or tuning stubs. Manual operation and computer-controlled hardware operation are simplified because mixer bias and tuning adjustments are not required.

11970 series harmonic mixers are available in six bands (15 to 17 dBm LO)

Agilent Model	Frequency Range (GHz)	LO Harm Number	Conversion Loss (dB)	Noise Level (dB) 1 kHz RBW	Freq. ¹ Response (dB)	Gain Compression (dBm)
11970K	18 to 26.5	6+	24	-105	±1.9	-3
11970A	26.5 to 40	8+	26	-102	±1.9	-5
11970Q	33 to 50	10+	28	-101	±1.9	-7
11970U	40 to 60	10+	28	-101	±1.9	-7
11970V	50 to 75	14+	40	-92	±2.1	-3
11970W	75 to 110	18+	47	-85	±3.0	-1

¹ Frequency response of the mixers is reduced by 1 dB for LO range of 14 to 18 dBm.

Compatibility

The 11970 series mixers extend the frequency range of the PSA Series (E4440A/47A/46A/48A) high-performance spectrum analyzers, the 8560EC series portable spectrum analyzers, ESA (E4407B) portable mid-performance spectrum analyzers, the 8566B spectrum analyzer (used with the 11975A amplifier), and the 70000 modular measurement system (used with the 70907A/B external mixer interface modules).

11970 and 11974 Series Specifications

IF Range: dc to 1.3 GHz

LO Amplitude Range: +14 dB to +16 dB; +16 dB optimum

Calibration Accuracy: ±2 dB for 11970 series with optimum LO amplitude

Typical RF Input SWR: <2.2:1, <3.0:1 for 11974 series

Bias Requirements: None

Typical Odd-Order Harmonic Suppression: >20 dB

(does not apply to 11974 series)

Maximum CW RF Input Level: +20 dBm (100 mW), +25 dBm for 11974 series

Maximum Peak Pulse Power: 24 dBm (250 mW) with <1 μs pulse (avg. power = +20 dBm)

Bandwidth: 100 MHz minimum (11974 series only)

Environmental: Meets MIL-T-28800, Type III, Class 3, Style C

IF/LO Connectors: SMA (female)

TUNE IN Connector: BNC

LO Range: 3 to 6.1 GHz

Key Literature & Web Link

11970 Series Technical Data, p/n 5968-1445E

11974 Series Technical Data, p/n 5952-2748

Ordering Information

11974A 26.5 to 40 GHz Preselected Mixer

11974Q 33 to 50 GHz Preselected Mixer

11974U 40 to 60 GHz Preselected Mixer

11974V 50 to 75 GHz Preselected Mixer

11974V-003 Delete Power Supply (11974 series only)

11970K 18 to 26.5 GHz Mixer

11970A 26.5 to 40 GHz Mixer

11970Q 33 to 50 GHz Mixer

11970U 40 to 60 GHz Mixer

11970V 50 to 75 GHz Mixer

11970W 75 to 110 GHz Mixer

11970

11970-009 Mixer Connection Set adds three 1-m low-loss SMA cables, wrench, Allen driver for any 11970 series mixer

11975A 2 to 8 GHz Amplifier

281A/B Coaxial to Waveguide Adapters

R281A 26.5 to 40 GHz, 2.4 mm (f)

R281B 26.5 to 40 GHz, 2.4 mm (m)

Q281A 33 to 50 GHz, 2.4 mm (f)

Q281B 33 to 50 GHz, 2.4 mm (m)

Signal Analyzers Amplifiers and Accessories

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Signal Analyzer Accessories, RF and Microwave Amplifiers

11867A and N9355/56 Series Limiters

Protect the input circuits of spectrum analyzers, counters, amplifiers and other instruments from high power levels with minimal effect on measurement performance. The 11867A RF limiter (dc to 1.8 GHz) reflects signals up to 10 W average power and 100 W peak power. Insertion loss is less than 0.75 dB. The N9355/56 series microwave limiters cover frequency ranges from 10 MHz to 18 GHz (N9355B/56B), to 26.5 GHz (N9355C/56C), and to 50 GHz (N9355F), respectively. They provide the best broadband input power protection to sensitive RF and microwave instruments with low insertion loss. Typical limiting threshold for the N9355 limiters is 10 dBm and that for the N9356 is 25 dBm.

11825B Impedance Matching Adapter

Impedance matching adapters are instrument grade tools used in RF and microwave signal matching that adapt 50-ohm impedance to 75-ohm impedance or vice versa. The 11825B minimum loss adapter is a 50 Ω to 75 Ω or 75 Ω to 50 Ω impedance converter with type-N connectors, operating from DC to 3 GHz. Use the Agilent 11825B Option 004 (50 Ω type-N(f), 75 Ω type-N(m)) for spectrum analyzers with 50 Ω input impedance when the 50 Ω /75 Ω impedance conversion is required.

85024A Probe (300 kHz to 3 GHz)

In-circuit measurements are made easy with this 300 kHz to 3 GHz probe. Input capacitance of 0.7 pF shunted by 1 M Ω resistance permits high-frequency probing without adverse loading of the circuit under test. Excellent frequency response and unity gain guarantee highly accurate swept measurements. High sensitivity and low distortion levels allow measurements that take advantage of full analyzer dynamic range.

87405B/C Preamplifiers

Agilent 87405B/C operates from the operating frequency as low as 100 MHz up to 18 GHz. They provide a low noise figure of 4.5 dB on 87405C model and 5 dB on 87405B model and gain from 24 dB. These will improve the dynamic range and sensitivity of your test equipment. With its convenient probe-power bias, the 87405B/C preamplifiers are ideal use as the front end preamplifier for a variety of Agilent instruments such as PSA, ESA, MXA, EXA, and CSA spectrum/signal analyzers. They also come in a rugged and portable design which will ease the use in many field applications. As a whole, Agilent 87405B/C preamplifiers improve the overall system performance and help reduce system errors with reliable gain and low noise figure.

Ordering Information

87405B Preamplifier (10 MHz to 4 GHz)
87405C Preamplifier (100 MHz to 18 GHz)
Cable Options (must order one)
87405C-101 Cables – Banana Plugs
87405C-102 Cables – Probe Power Bias
87405C-103 Cables – DSUB 15 pin

8449B Preamplifier (1 to 26.5 GHz)

This high-gain, low-noise preamplifier increases the sensitivity of any RF/microwave spectrum analyzer for detection and analysis of very low level signals. The improved sensitivity can dramatically reduce measurement time.

8447A and 8447D Amplifiers

The Agilent 8447A and 8447D are low-noise, high gain amplifiers used to improve the sensitivity of counters, spectrum analyzers, RF voltmeters, EMI meters, power meters and other devices. They will also increase the maximum power available from a signal generator or sweeper.

Specifications

	8447A Amplifier	8447D Amplifier
Frequency Range	0.1 to 400 MHz	100 kHz to 1.3 GHz
Typical 3 dB Bandwidth	50 kHz to 700 MHz	75 kHz to 1.7 GHz
Gain (mean, per channel)	20 dB \pm 1.0 dB at 10 MHz (20° to 30°C)	>25 dB (20° to 30°C)
Gain Flatness Across Full Frequency Range	\pm 1.8 dB (0° to 55°C) \pm 0.7 dB (20° to 30°C) characteristic	\pm 1.5 dB
Noise Figure	<7 dB	<8.5 dB
Output Power for 1 dB Gain Compression	>+6 dBm	>+7 dBm typical
Harmonic Distortion	–32 dB for 0 dBm output	–30 dB for 0 dBm output (typical)
Output for <–60 dB Harmonic Distortion	–25 dBm (characteristic)	–30 dBm
VSWR	<1.7	<2.0 input <2.2 output 1 to 1300 MHz
Reverse Isolation	>30 dB	>40 dB
Maximum dc Voltage Output	\pm 10 V	\pm 10 V
Size	85.8 mm H x 130 mm W x 261 mm D (3.4 in x 5.1 in x 8.5 in)	85.8 mm H x 130 mm W x 216 mm D (3.4 in x 5.1 in x 8.5 in)
Weight	Net, 1.56 kg (3.4 lb); Shipping, 2.3 kg (5.1 lb)	Net, 1.56 kg (3.4 lb); Shipping, 2.3 kg (5.1 lb)
Power Requirements	110 or 230 Vac + 10 %, 48 to 440 Hz, 15 W	110 or 230 Vac + 10 %, 48 to 440 Hz, 15 W
Options Available	Option 001: Dual-channel amp, BNC (f) connectors	Option 001: Dual-channel amp, BNC (f) connectors Option 010: Single-channel amp, Type-N (f) connectors Option 011: Dual-channel amp, Type-N (f) connectors

Key Literature & Web Link

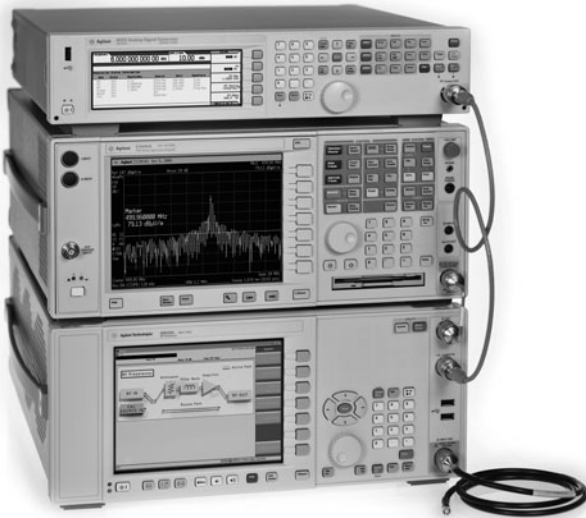
For more information, visit our site: www.agilent.com/find/mta

Ordering Information

8447A Amplifier
8447D Amplifier

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- RF preselection from 9 kHz to 1 GHz
- CISPR bandwidths (200 Hz, 9 kHz, 120 kHz and 1 MHz)
- CISPR detectors (quasi-peak, peak and average)
- Limit lines and limit margins
- Correction factors for antennas, cables, amplifiers and other devices
- Preselector filter alignment using external signal source
- Built-in limiter for conducted emissions protection
- Preamplifier for greater sensitivity
- 8192 data points for wider scans



EMI Measurement Receiver

N9039A

Combine the world class performance of the E444xA PSA spectrum analyzer and the new N9039A RF preselector and the result is an accurate, fast EMI measurement receiver. This new receiver gives you the confidence that the measurements you make are accurate and repeatable.

Agilent's new EMI measurement system offer excellent amplitude and frequency accuracy across the entire band. Delivering 8192 data points per sweep, this system allows you to analyze very broad spans with the resolution recommended by CISPR. In addition, you can quickly switch from bypass to preselected mode for fully compliant measurements.

With the systems excellent amplitude accuracy, you can reduce your margins and increase you pass rate.

Specifications

- Radiated emissions bands sensitivity to 1 GHz: -152 dBm
- Absolute amplitude accuracy ± 1.0 dB, 9 kHz to 1 GHz
- Input VSWR 1.2:1
- Preselected TOI +15 dBm
- Span accuracy @ 100 MHz: 20 kHz typical

Key Literature & Web Link

EMI Measurement Receiver, p/n 5989-6807EN

www.agilent.com/find/emi

Ordering Information

E444xA-239 PSA Spectrum Analyzer with EMI Personality

N9039A RF Preselector

N5181A Signal Generator (required for alignment)

E7400A
Series EMC
Analyzers



E7400A Series EMC Analyzers

Whether your industry is information technology, automotive, communications, or medical electronics, you need to evaluate the EMI performance of your products during the development phase. With Agilent's E7400A Series EMC analyzers, you can evaluate performance quickly and easily.

EMC Express Analyzers Provide Ordering Ease, Faster Delivery, and Best Value

The EMC analyzer is available in two "express option" choices. Express analyzer options are based on the most frequently ordered EMC configurations and most popular options. Express analyzers are favorably priced and provide faster delivery.

Radiated Emissions

When combined with a broadband antenna, the E7400A Series analyzer provides the capabilities to check for radiated emissions coming from your DUT. This is best done in an area that is free from reflective objects such as an open area or EMI chamber.

Conducted Emissions

Test for noise or interference placed on power or data lines by coupling the E7400A series instrument to the power or data line through a line impedance stabilization network (LISN) device or absorbing clamp.

Diagnostics and Problem Isolation

If you have an emissions problem, you can use the E7400A with an 11940A or 11941A close field probe to isolate and diagnose the source of the problem.

Extensive Feature Set Enables Quick Measurements

The E7400A Series EMC analyzers have the following functionality and features to speed you through measurements:

- Detectors to perform peak, quasi-peak, and average measurements
- Complete measurement setups including span and EMI bandwidths
- Display two limit lines and margins
- Corrections for antennas, cables, and amplifiers
- Measure peak, quasi-peak, and average amplitudes of 2000 signals and store the results into the internal list
- Use the "Zone" feature to zoom in on a signal while viewing the broad spectrum
- Built-in 3.5 inch disk drive
- Large, crisp color display
- Built-in preamplifier with 20 dB nominal gain
- Sort, remeasure, mark, and delete signals in the internal list
- Standard GPIB and parallel ports
- Battery pack available
- Edit or customize and store limit lines and correction factors
- Optional built-in tracking generator to 3 GHz

Ordering Information

E7400A Series EMC Analyzer (Express Option STD/STG)

Available Models

E7402A (30 Hz to 3.0 GHz)

E7405A (30 Hz to 26.5 GHz)

The EMC standard analyzer (option STD) includes all the options listed below. To receive a standard analyzer with a tracking generator order option STG instead of STD.

Options included with STD or STG

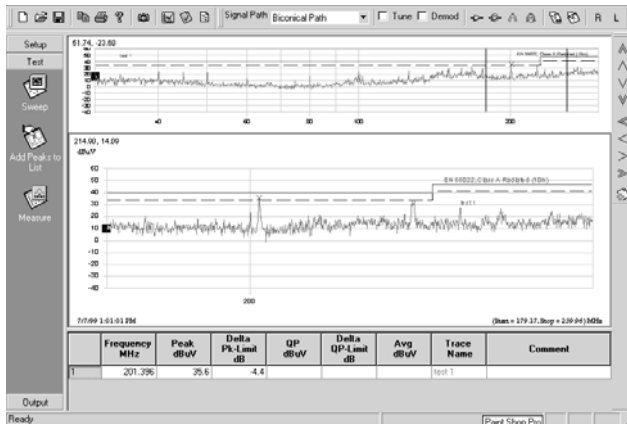
GPIB connection	A4H
EMI detectors and FM demod	AYQ
Fast time domain sweep, IF and video output ports	AYX
100 Hz (30 Hz usable) frequency range extension	UKB
Low emissions shielding	060
Narrow resolution bandwidths (1 Hz resolution)	1DR
Preamplifier built-in for enhanced sensitivity (operates to 3 GHz)	1DS
High stability frequency reference	1D5
EMC measurement firmware (automated EMC measurements; available from www.agilent.com/find/emc)	***
IntuiLink PC connectivity software (connects to Microsoft Word and Excel)	***

Available Options

50 ohm tracking generator (9 kHz to 3.0 GHz) (equivalent to Option 1DN)	STG
Replace GPIB connection (A4H) with serial port (not compatible with Option A4H or E7415A EMI measurement software)	1AX
Time-gated spectrum analysis	1D6

PC Software for the E7400A Series

IntuiLink PC software provides easy transfer of EMC measurement trace data directly into MS Excel spreadsheets or screen images into MS Word documents for analysis, archiving, presentations, or printing. Transfer measurement results over GPIB, RS232, or LAN (using an E2050A GPIB/LAN adapter). Save and restore analyzer states. Unattended operation with repetitive sequence of measurement transfers by date and time. IntuiLink is included standard with GPIB and RS232 options.



E7415A EMI Measurement Software

Choose the level of automation you need, from simple data capture from your EMC analyzer or receiver to fully automated EMI measurements. With the E7415A, you can select the measurement resolution over the span of interest or use the auto-select feature.

Zoom in on an area for a closer look simply by dragging a cursor. Point and click to mark individual signals and add them to a list or use the "Add Peaks to List" function to add all the signals above a limit or margin to a list with one click. Highlight signals in the list to measure peak, quasi-peak and average amplitude or tune and listen.

Generate a report by selecting from a wide range of entries. Your report may include a graph, limit lines, equipment table, transducer factors etc.

The E7415A controls the E7400A Series EMC analyzers as well as the 8590EM Series EMC analyzer and 8546A/42E EMI receivers.

11940A and 11941A Close-Field Probes and 11945A Close-Field Probe Set

These handheld probes are designed to measure magnetic-field radiation from surface currents, slots, cables, and ICs for EMC diagnostic and troubleshooting measurements. Their unique design results in a high level of electric-field rejection. This significantly reduces errors, thus allowing calibrated and repeatable measurements.

The 11941A operates from 9 kHz to 30 MHz, the 11940A, from 30 MHz to 1 GHz. Five antenna factors appear on each probe for calculating absolute magnetic-field strength (dBμA/m) from the dBμV reading of a spectrum analyzer. Each probe is calibrated and comes with a 2-meter RG-223 coaxial cable, and SMA(f)-to-type-N(m) adapter, and an SMA (f)-to-BNC(m) adapter.

The 11945A close field probe set includes both the 11940A and 11941A probes for full coverage from 9 kHz to 1 GHz. Option E51 adds the 11909A preamplifier, with a 36-inch (914-mm) type-N cable, and a carrying bag for storage and protection of the entire set.

119XX Series Antennas

These antennas are individually calibrated and shipped with a calibration certificate showing actual performance data. The series includes the following products:

Model		Frequency Range
11955A	Biconical Antenna ¹	30 to 300 MHz
11956A	Log Periodic Antenna ¹	200 MHz to 2 GHz
11966E	Double-Ridged Waveguide Horn Antenna	1 to 18 GHz
11966J	Double-Ridged Waveguide Horn Antenna	18 to 40 GHz
11966L	Coax Cable, Type-N	10 m
11966P	Broadband Antenna	30 MHz to 2 GHz

¹ Typical cal factor supplied.

These antennas may be ordered directly from ETS Lindgren (www.ETS-Lindgren.com). The E7400A Series EMC Analyzers will also work with most third party antennas, LISNs, and other EMC accessories.

11967D Line Impedance Stabilization Network

Used for commercial conducted measurements. Maximum current 10 amps. Includes options for SCHUKO, NEMA, and British power outlet connectors.

11974A Transient Limiter

A Transient Limiter protects the EMC analyzer's input from damage caused by high-level transients. The 11974A is recommended for use with LISN device.

11909A Preamplifier

Improve receiver, sensitivity for more accurate radiated emissions measurements. This amplifier has 32 dB gain with a 1.8 dB noise figure. This amplifier is ideal for use with the 11940A and 11941A close field probes to detect low level signals from device-under-test. Frequency range is 9 kHz to 1 GHz.

8449B Microwave Preamplifier

This high-gain, low-noise preamplifier adds sensitivity for MIL-STD radiated measurements. Frequency range is 1 to 26.5 GHz.

Key Literature

E7400A Series EMC Analyzer Brochure, p/n 5968-2516E
 ESA/EMC Configuration Guide, p/n 5968-3412E
 E7400A Series Technical Specifications, p/n 5968-3662E
 EMC Precompliance Systems and Accessories Catalog, p/n 5988-3290EN
 EMC Precompliance Cookbook (AN 1328), p/n 5968-3661E

E7415A
 11945A
 11940A
 11941A
 Various
 EMC
 Accessories

- A flexible and intuitive user interface
- Easy measurement setup
- Low instrument uncertainty
- Color graphical display of noise figure and gain versus frequency
- Enhanced PC and printer connectivity
- SNS, 346 and 347 Series noise source compatible
- Ability to automatically upload ENR calibration data from SNS Series noise source
- Local oscillator control through second dedicated GP-IB



N8973A

NFA Series

A Flexible and Intuitive User Interface

The user interface on the NFA series of Noise Figure Analyzers is intuitive and easy to use, with easy to find keys, which are sized and then placed in the relevant key group according to function. The soft-key depths have been kept to a minimum and there are clear visual indicators on the screen showing the current machine state.

Easy Measurement Setup

The NFA series of Noise Figure Analyzers now takes the pain out of complex measurement setups, with their simple but instructive menus. The built-in help button gives key function and remote programming commands, that should eliminate the need to carry manuals when setting up measurements.

Low Instrumentation Uncertainty

When making noise figure measurements, a key parameter to be aware of is measurement uncertainty. The NFA has a low instrumentation uncertainty to aid in accurate and repeatable measurement of manufacturers' components. In addition, to aid customers in setting their components/systems specifications, Agilent has produced a web-based uncertainty calculator that will give customers information on how to improve and classify their measurement specifications more accurately.

For more information, visit our web site at: www.agilent.com/find/nf

Increase Measurement Throughput

In manufacturing environments, fast measurement speed and repeatability are critical. The NFA series of Noise Figure Analyzers include many features that can reduce your measurement time and increase throughput. The frequency list function allows you to select specific points within a complete measurement span to make your measurement. The Sweep averaging function allows a real-time update to the screen during a measurement, as you adjust the performance of the DUT during a sweep. Both these functions, as well as the limit line functionality for quick and easy pass/fail testing and the additional ability to recall complete calibrated instrument states, increase productivity and measurement throughput.

Enhanced Connectivity

The built-in floppy disk drive, GPIB, RS232 serial and Printer port connectors allow data transfer between the analyzer and a PC or workstation. There is also a built-in VGA connector for connecting a large-screen monitor.

Color Graphical Display

To enhance usability, the Noise Figure Analyzers come with an integrated 17 cm full color LCD display, for simultaneous viewing of noise figure and gain against frequency. There are three different formats for viewing measurements, the two separate channel or combined graph format, a table format, and a spot frequency noise figure and gain measurement "meter" format.

Ease of Automation

The NFA series of Noise Figure Analyzers include 2 industry-standard GPIB ports and an RS232 serial port, to aid in the automated control of the instrument. The second GPIB port is dedicated to Local oscillator control. The default control language is SCPI, but users can also define custom LO commands.

Ease of Integration

To aid with the integration of the analyzer into manufacturing environments, Agilent has produced a Programmers Reference Manual containing example programs to help migrate to the new system. The NFA is not code compatible with the 8970B, nor can it control the 8971C.

Full Measurement Capability

Features present in all NFA series noise figure analyzers

- ENR data automatically loaded into NFA series noise figure analyzer when using SNS noise source
- Floppy disk loading and saving of ENR data when used with a 346 or 347 noise source
- Enhanced analysis through Limit lines and Marker functions
- Enhanced PC and printer connectivity and VGA output
- Internal data storage capable of storing up to 30 different state, trace, and setup files (dependent upon measurement complexity)
- 4 MHz measurement bandwidth
- Frequency list mode, which enables the user to avoid known, polluted frequencies during a measurement or, used tactically to speed up a measurement

Features Available

- Lower noise figure measurement uncertainty ± 0.05 dB
- Six user selectable bandwidths (100 KHz, 200 KHz, 400 KHz, 1 MHz, 2 MHz, and 4 MHz)

NFA Series Key Specifications

Specifications apply over 0°C to +55°C unless otherwise noted. The analyzer will meet its specifications after 2 hours of storage within the operating temperature range, 60 minutes after the analyzer is turned on, with Alignment running. A user calibration is required before corrected measurements can be made.

Frequency Range

NFA Series:

N8973A	10 MHz to 3 GHz
N8974A	10 MHz to 6.7 GHz
N8975A	10 MHz to 26.5 GHz

Measurement Speed (nominal)

	8 Averages	64 Averages
N8973A:	<50 ms/measurement	<42 ms/measurement
N8974A:	<70 ms/measurement	<50 ms/measurement
N8975A:	<70 ms/measurement	<50 ms/measurement

Measurement Bandwidth (nominal)

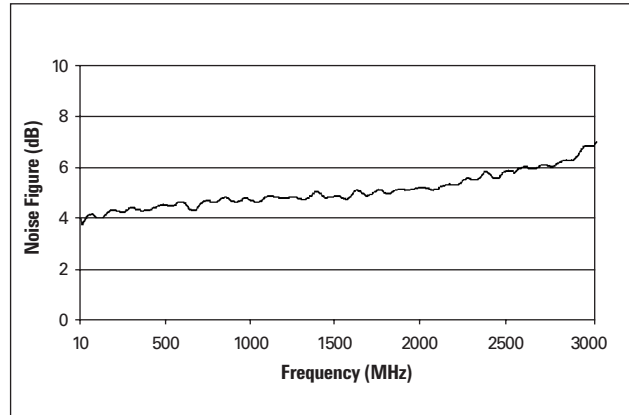
N8973A, N8974A, N8975A: 4 MHz, 2 MHz, 1 MHz, 400 kHz, 200 kHz, 100 kHz

Noise Figure and Gain

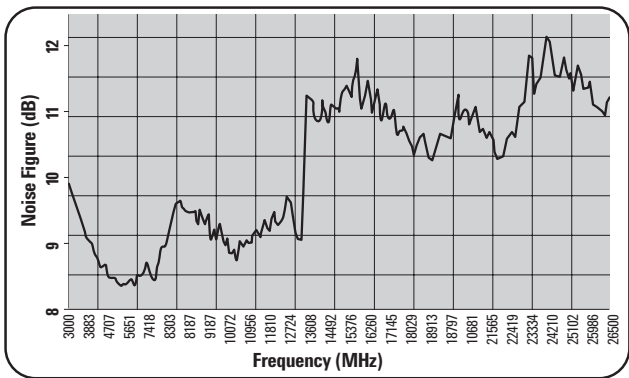
(Performance is dependent upon ENR of noise source used)

N8973A, N8974A and N8975A (10 MHz to 3.0 GHz)	Noise Source ENR		
	4 – 7 dB	12 – 17 dB	20 – 22 dB
Noise Figure			
Measurement range	0 to 20 dB	0 to 30 dB	0 to 35 dB
Instrument uncertainty	±0.05 dB	±0.05 dB	±0.1 dB
Gain			
Measurement range	–20 to +40 dB		
Instrument uncertainty	±0.17 dB		
N8974A and N8975A (>3.0 GHz)	Noise Source ENR		
	4 – 7 dB	12 – 17 dB	20 – 22 dB
Noise Figure			
Measurement range	0 to 20 dB	0 to 30 dB	0 to 35 dB
Instrument uncertainty	±0.15 dB	±0.15 dB	±0.2 dB
Gain			
Measurement range	–20 to +40 dB		
Instrument uncertainty	±0.17 dB		

Characteristic¹ Noise figure at 23°C ± 3°C (10 MHz to 3.0 GHz)



Characteristic¹ Noise figure at 23°C ± 3°C (3.0 GHz to 26.5 GHz)



Characteristic values are met or bettered by 90% of instruments with 90% confidence.

Frequency Reference

	Standard	Opt.1D5
Aging	±<2 ppm ¹ /year	±<0.1 ppm/year
Temperature stability	±<6 ppm	±<0.01 ppm
Settability	±<0.5 ppm	±<0.01 ppm

Tuning Accuracy (Start, Stop, Center, Marker)

4 MHz Measurement Bandwidth (default on all models of Noise Figure Analyzer)

Frequency	Error
10 MHz – 3.0 GHz	±<Reference error + 100 kHz
3.0 GHz – 26.5 GHz	±<Reference error + 400 kHz

<4MHz Measurement Bandwidth (functionality not present in N8972A)

Frequency	Error
10 MHz – 3.0 GHz	±<Reference error + 20 kHz
3.0 GHz – 26.5 GHz	±<Reference error + 20% of measurement bandwidth

¹ Parts Per Million (10e-6).

N8973A
N8974A
N8975A

Noise Figure Analyzers

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Noise Figure Analyzers, NFA Series (cont.)

N8973A
N8974A
N8975A

General Specifications

Dimensions

Without handle: 222 mm H x 375 mm W x 410 mm D
With handle (max): 222 mm H x 409 mm W x 515 mm D

Weight (typical, without options)

N8973A: 15.5 kg
N8974A: 17.5 kg
N8975A: 17.5 kg

Data Storage (nominal)

Internal drive: 30 traces, states or ENR tables
Floppy disk: 30 traces, states or ENR tables

Power Requirements

On (line 1): 90 to 132 V rms, 47 to 440 Hz, 195 to 250 V rms, 47 to 66 Hz
Power consumption: <300 W
Standby (line 0): <5 W

Temperature Range

Operating: 0°C to +55°C
Storage: -40°C to +70°C

Humidity Range

Operating: Up to 95% relative humidity to 40°C (non-condensing)
Altitude range: Operating to 4,600 meters

Calibration Interval

1-year minimum recommended

Electromagnetic Compatibility

Complies with the requirements of the EMC directive 89/336/EEC. This includes Generic Immunity Standard EN 50082-1:1992 and Radiated Interference Standard CISPR 11:1990/EN 55011:1991, Group 1 Class A. The conducted and radiated emissions performance typically meets CISPR 11:1990/EN 55011:1991 Group 1 Class B limits.

Warranty

1-Year warranty as standard

Key Literature

Noise Figure Analyzers, NFA Series Brochure, p/n 5980-0166E
Noise Figure Analyzers, NFA Series Data Sheet, p/n 5980-0164E
Noise Figure Analyzers, NFA Series Configuration Guide, p/n 5980-0163E
Fundamentals of RF and Microwave Noise Figure Measurements
Application Note 57-1, p/n 5952-8255E
Noise Figure Measurement Accuracy Application Note 57-2, p/n 5952-3706
10 Hints for Making Successful Noise Figure Measurements, p/n 5980-0228E
NFA Series, Noise Figure Analyzer Programming Examples, p/n 5968-9498E

Ordering Information

N8973A 10 MHz to 3.0 GHz NFA Series Noise Figure Analyzer
N8974A 10 MHz to 6.7 GHz NFA Series Noise Figure Analyzer
N8975A 10 MHz to 26.5 GHz NFA Series Noise Figure Analyzer

All options, other than those marked with *, can be ordered at any time for use with an instrument.

Frequency Reference

N897xA-1D5 NFA series high stability frequency reference*

Calibration Documentation

N897xA-A6J NFA series ANSI Z540 compliant calibration with test data*

Accessories

N897xA-1CP NFA series rackmount and handle kit
N897xA-UK9 NFA series front panel cover
N897xA-1FP NFA series calibration, performance verification and adjustment software

Documentation

A hard copy and CD version of the English language Quick Reference Guide, User's Guide, Programmers Reference, and Calibration and Performance Verification Manual are included with the NFA as standard. Selections can be made to change the localization of the manual set or to delete the hardcopy.

N897xA-AB0 NFA series manual set for Taiwan – Chinese localization
N897xA-AB1 NFA series manual set – Korean localization
N897xA-AB2 NFA series manual set – Chinese localization
N897xA-ABE NFA series manual set – Spanish localization
N897xA-ABF NFA series manual set – French localization
N897xA-ABZ NFA series manual set – Italian localization
N897xA-ABD NFA series manual set – German localization
N897xA-ABJ NFA series manual set – Japanese localization
N897xA-OB0 Delete hardcopy manual set*

Additional Documentation

N897xA-OB1 NFA series manual set (English version)
N897xA-OB2 NFA series user manual (English version)
N897xA-OBF NFA series programmers reference (English version)

Service Options:

Warranty and Service

Standard warranty is 1 year.

Calibration¹

For 3 years, order 36 months of the appropriate calibration plan shown below. For 5 years, specify 60 months.

R-50C-001 Standard calibration plan*

R-50C-002 Standard compliant calibration plan*

¹ Options not available in all countries.

Note: The localized options will include a localized version of the Quick Reference Guide and User Guide, and an English language version of the Programmers Reference, and Calibration and Performance Verification Manual.

- Agilent noise sources with frequency range from 10 MHz to 50 GHz
- Excess noise ratio (ENR) selected for a variety of user applications
- SNS series of noise sources have stored ENR data, decreasing the opportunity for user error

SNS Series



SNS Series Noise Sources

The Agilent SNS series of noise sources work in conjunction with the Agilent NFA series of noise figure analyzer to simplify measurement set-up and improve accuracy. When connected to the Agilent, NFA series, the noise source automatically downloads electronically stored calibration data to the analyzers. The SNS series also connects to Agilent's ESA spectrum analyzers, or MXA and EXA signal analyzers. The noise sources also have the capability to automatically measure their own temperature so that compensation can be applied to the calibration data. These capabilities increase the overall reliability and accuracy of the noise figure measurement. The SNS noise sources can be used for a various applications with a range of frequencies, Excess Noise Ratio (ENR) and coaxial connector types.

SNS Series Partial Specifications

Instrument Model	Frequency Range	ENR Value
N4000A	10 MHz to 18 GHz	4.5 – 6.5 dB
N4001A	10 MHz to 18 GHz	14 – 16 dB
N4002A	10 MHz to 12 GHz 12 GHz to 26.5 GHz	12 – 16 dB 14 – 17 dB

Instrument Model	Frequency Range (GHz)	Max SWR	Reflection Coefficient
N4000A	0.01 to 3.0	<1.04	0.02
	3.0 to 7.0	<1.13	0.06
	7.0 to 18.0	<1.22	0.10
N4001A	0.01 to 3.0	<1.15	0.07
	3.0 to 7.0	<1.20	0.09
	7.0 to 18.0	<1.25	0.11
N4002A	0.01 to 3.0	<1.22	0.10
	3.0 to 7.0	<1.25	0.10
	7.0 to 18.0	<1.25	0.11
	18.0 to 26.5	<1.35	0.15

Ordering Information

N4000A SNS Series Noise Source, 10 MHz to 18 GHz, nominal ENR 6 dB
N4001A SNS Series Noise Source, 10 MHz to 18 GHz, nominal ENR 15 dB
N4002A SNS Series Noise Source, 10 MHz to 26.5 GHz, nominal ENR 15 dB
 All of the SNS series noise sources are provided with an APC 3.5 (male) connector as standard.

Connector

N400xA-001 Type-N (m) connector

Custom Solution

N400xA-H10 Gold standards calibration (for use with the N2002A)

Service Options:

Warranty and Service

Standard warranty is 1 year.

For warranty and service of 3 years, please order R-51B-001-3C: "1 year Return-to-Agilent warranty extended to 3 years" (quantity = 1).

Calibration¹

For 3 years, order 36 months of the appropriate calibration plan shown below. For 5 years, specify 60 months.

R-50C-001 Standard calibration plan

R-50C-002 Standard compliant calibration plan



346A/B/C Broadband Noise Sources

346 Series Noise Sources

The Agilent 346 series of noise sources work in conjunction with the Agilent NFA series noise figure analyzer and the PSA series spectrum analyzer to make accurate and reliable noise figure measurements. Each 346 noise source has individually calibrated ENR values at specific frequencies. The calibration data is printed on the label of the noise source and can be manually entered into the NFA or PSA. A floppy disk is also provided with the calibration data, for rapid entry of ENR data into the NFA or PSA. The 346 noise sources are designed for a broad range of measurement applications, with a range of frequencies, Excess Noise Ratio (ENR) and coaxial connector types.

Customer Solution Noise Sources

346B with option 346B-H01 High ENR Noise Source

The 346B-H01 has high ENR (21 dB typical), suitable for measuring high noise figure devices.*

346B with option 346B-H42 DBS Noise Source

The 346B-H42 was developed especially to test low noise block converters (LNB) used for Direct Broadcast Satellite (DBS). WR75 wave-guide output, 5 dB ENR, low ENR calibration uncertainty, and low SWR improve the noise figure measurement accuracy of DBS LNBs.*

346CK01 Broadband Noise Source

This coaxial noise source features coverage from 1 to 50 GHz with the 2.4 mm coaxial connector. ENR is nominally 20 dB at 1 GHz and 7 dB at 50 GHz.*

346 Series Partial Specifications

Instrument Model	Frequency Range	ENR Value
346A	10 MHz to 18 GHz	4.5 – 6.5 dB
346B	10 MHz to 18 GHz	14 – 16 dB
346C	10 MHz to 12 GHz	12 – 16 dB
	12 GHz to 26.5 GHz	14 – 17 dB

Instrument Model	Frequency Range (GHz)	Max SWR	Reflection Coefficient
346A/B	0.01 to 3.0	1.3	0.13
	3.0 to 5.0	1.15	0.07
	5.0 to 18.0	1.25	0.11
346C	0.01 to 18.0	1.25	0.11
	18.0 to 26.5	1.35	0.15

¹ Option not available in all countries.

* Contact Agilent for technical specifications

Noise Figure Analyzers

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Noise Sources (cont.)

SNS Series
346 Series
N2002A

Ordering Information

346A 10 MHz to 18 GHz 346 Series Noise Source nominal ENR 5 dB
346B 10 MHz to 18 GHz 346 Series Noise Source nominal ENR 15 dB
346C 10 MHz to 26.5 GHz 346 Series Noise Source nominal ENR 15 dB
All of the 346 series noise sources are provided with an APC 3.5 (male) connector as standard.

Connectors (excludes 346C)

346x-001 Type N (male) connector
346x-002 APC-7mm connector
346x-004 Type N (female) connector

Calibration Documentation

346x-A6J ANSI Z540 compliant calibration with test data

Additional Documentation

346x-910 Extra operation manual

Custom Solution Options

346x-H10 Gold standards calibration (for use with the N2002A)
346B-H01 APC 3.5(m) connector with 21 dB nominal ENR
346B-H42 DBS Waveguide adapter and nominal ENR 5 dB
346CK01 1 GHz to 50 GHz 346 Series Noise Source nominal ENR 21 dB

Service Options:

Warranty and Service

Standard warranty is 1 year.

For warranty and service of 3 years, please order R-51B-001-3C: "1 year Return-to-Agilent warranty extended to 3 years" (quantity = 1).

Calibration¹

For 3 years, order 36 months of the appropriate calibration plan shown below. For 5 years, specify 60 months.

R-50C-001 Standard calibration plan

R-50C-002 Standard compliant calibration plan

R347B and Q347B Noise Sources

This series of broadband noise sources has been designed to cover high frequency waveguide measurement applications.

Agilent 347 Partial Specifications

Instrument Model	Frequency Range	ENR Value
R347B	26.5 to 44 GHz	10 – 13 dB
Q347B	33 to 42 GHz 42 to 50 GHz	10 – 13 dB 6 – 12.5 dB

Instrument Model	Frequency Range (GHz)	Max SWR	Reflection Coefficient
R347B	26 to 44	<1.42	0.17
Q347B	33 to 50	<1.57	0.22

Warranty

1-Year warranty as standard

- Simple calibration of noise sources with reduced uncertainty
- Traceable results to a national standard
- Availability for engineers who require on-site calibration



N2002A Noise Source Test Set

The N2002A Noise Source Test Set offers customers the opportunity to calibrate their own noise sources with minimal levels of uncertainty. With simple straightforward operations and low cost of equipment it is now viable that this process can occur "in-house" and thus drastically reduces downtime.

For engineers that currently run their own noise source calibration service, the N2002A noise source test set is an ideal addition to their test equipment. By incorporating this low-cost, self-contained unit into a wider noise source calibration system, high quality calibrations of noise sources can be made. When used within a noise source calibration system the N2002A and Agilent N8975A NFA series noise figure analyzer can also drastically reduce the calibration time.

Key Literature

N2002A Noise Source Test Set 10 MHz to 26.5 GHz, Product Overview, p/n 5988-7228EN

Agilent Noise Source Calibration, Using the Agilent N8975A Noise Figure Analyzer and the N2002A Noise Source Test Set, p/n 5988-7229EN

Ordering Information

N2002A Noise Source Test Set

Accessories

N2002A-001

Accessory cable and adapters
Cable (x1): 11500E
3.5 mm female to female adapter (x 3): 1250-1749
3.5 mm female to type-N (female) adapter (x1): 1250-1745

Warranty

1-Year warranty as standard

¹ Option not available in all countries.



Why Network Analysis?

Characterizing the behavior of linear electrical networks that will be stimulated by arbitrary signals and interfaced with a variety of other networks is a fundamental problem in both synthesis and test processes. For example, the engineer designing a multi-component network must predict with some certainty, from knowledge of the individual components, the final network performance. Similarly, a production manager must know allowable tolerances on the products manufactured and whether the final products meet the specified tolerances. Network analysis offers a solution to these problems through complete description of linear network behavior in the frequency domain. Additionally, some network analyzers offer the capability to transform measurement data, taken in the frequency domain, to the time domain, providing further insight into the behavior of linear networks.

Network analysis accomplishes the description of both active and passive networks by creating a data model of such component parameters as impedances and transfer functions. However, these parameters not only vary as a function of frequency but are also complex variables in that they have both magnitude and phase (see Figure 1). Swept network analyzers measure magnitude and phase (the total complex quantity) as a function of frequency with less difficulty than conventional CW measurements. Impedance and transfer functions then can be displayed conveniently on an internal display, or on peripherals such as a printer.

Thus, network analysis satisfies the engineering need to characterize the behavior of linear networks quickly, accurately, and completely over broad frequency ranges. Agilent Technologies manufactures a full line of scalar network analyzers (magnitude only) and vector network analyzers (both magnitude and phase).

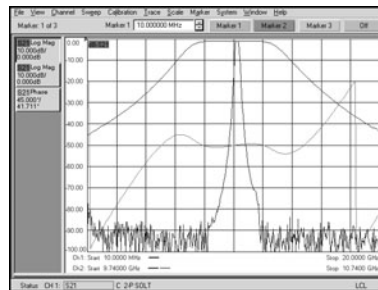


Figure 1: Simultaneous wideband and narrowband sweep of a microwave filter, showing magnitude and deviation from linear phase.

What is Network Analysis?

Network analysis is the process of creating a data model of the transfer and/or impedance characteristics of a linear network through stimulus-response testing over the frequency range of interest. All network analyzers in the Agilent product line operate according to this definition.

At frequencies above 1 MHz, lumped elements actually become “circuits” consisting of the basic elements plus parasitics like stray capacitance, lead inductance, and unknown absorptive losses. Since parasitics depend on the individual device and its construction, they are almost impossible to predict. Above 1 GHz component geometries are comparable to a signal wavelength, intensifying the variance in circuit behavior due to device construction.

Network analysis has classically been limited to the definition of linear networks. Since linearity constrains networks stimulated by a sine wave to produce a sine-wave output, sine-wave testing is an ideal method for characterizing magnitude and phase response as a function of frequency. Modern network analyzers use sine-wave power sweeps to characterize certain

parameters of nonlinear behavior, such as gain compression and AM-to-PM. They can also measure frequency translation devices by offsetting the receivers for the source stimulus. Additionally, the source can be pulsed to produce pulsed S-parameters.

Network Analyzers

Agilent network analyzers are instruments that measure transfer and/or impedance functions of linear networks through sine-wave testing (see Figure 2). A network analyzer system accomplishes these measurements by configuring its various components around the device-under-test. The first requirement of the measurement system is a sine-wave signal source to stimulate the device-under-test. Since transfer and impedance functions are ratios of various voltages and currents, a means of separating the appropriate signals from the measurement ports of the device-under-test is required. Finally, the network analyzer itself must detect the separated signals, form the desired signal ratios and display the results.

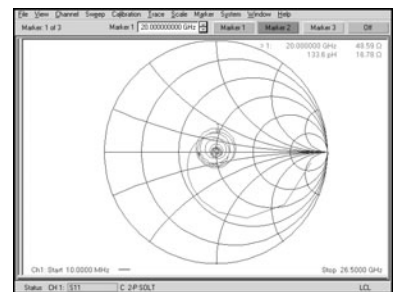


Figure 2: Input impedance of a broadband microwave amplifier is read directly with a Smith Chart display.

Signal Sources and Signal Separation

In the general case, any sine-wave source meeting the network analyzer’s specifications can be used to stimulate the device-under-test. If the analyzer is capable of swept measurements, great economies in time can be achieved by stimulating the device-under-test with a sweep oscillator or synthesized sweeper. Most Agilent network analyzers contain internal, synthesized sources with excellent frequency resolution. Swept measurements allow quick and easy characterization of devices over broad frequency ranges.

At high frequencies the problem of signal separation usually involves traveling waves on transmission lines and becomes correspondingly more difficult. Agilent network analyzers employ both internal and external test sets applicable for separating the appropriate traveling waves in a variety of high-frequency measurements.

Broadband and Narrowband Detection

After the desired signals have been obtained from the test set, they must be detected by the network analyzer; Agilent network analyzers can use one of two detection methods. Broadband detection accepts the full-frequency spectrum of the input signal, while narrowband detection involves tuned receivers that convert CW or swept-RF signals to a constant-IF signal. There are certain advantages to each detection scheme.

Scalar analyzers usually employ broadband detection techniques. Broadband detection reduces instrument cost by eliminating the IF section required by narrowband analyzers but sacrifices noise and harmonic rejection. However, noise is not a factor in many applications. Finally, broadband systems can make measurements where the input and output signals are not of the same frequency, as in the measurement of the insertion loss of mixers and frequency doublers.

Vector network analyzers normally employ narrowband detection techniques. Narrowband detection makes a more sensitive low noise detection of the constant IF possible. This allows increased accuracy and dynamic range for frequency-selective measurements (as compared to broadband systems).

Vector network analyzers can vary with their employment of broadband, narrowband, or both types of detection. When both types of detection are available, the user selects the detection method, which allows optimization of the device measurements.

Signal Processing and Display

Once the RF has been detected, the network analyzer must process the detected signals and display the measured quantities (see Figure 3). All Agilent network analyzers are multi-channel receivers utilizing a reference channel and at least one test channel; absolute signal levels in the channels, relative signal level (ratios) between the channels, or relative phase difference between channels can be measured, depending on the analyzer.

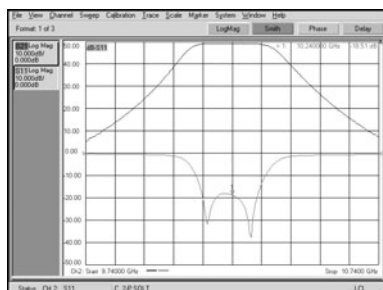


Figure 3: Simultaneous measurement of transmission response and passband reflection return loss.

Relative ratio measurements are usually made in dB, which is the log ratio of an unknown signal (Test Channel) with a chosen reference signal (Reference Channel). This allows the full dynamic range of the instrumentation to be used in measuring variations of both high- and low-level circuit responses. For example, 0 dB implies the two signal levels have a ratio of unity, while ± 20 dB implies a 10:1 voltage ratio between two signals.

All network analyzer phase measurements are relative measurements with the reference channel signal considered to have zero phase. The analyzer then measures the phase difference of the test channel with respect to the reference channel.

Phase information complements amplitude data in the measurement of device parameters. Phase is more sensitive to network behavior and it is a required component of complex impedance and transfer functions.

Phase data is also required to measure delay distortion or group delay of networks. Delay distortion occurs when different frequency components of a complex waveform experience nonlinear phase shifts as they are transmitted through a network. Group delay (see Figure 4) is a measure of this distortion and is defined as:

$$T_{gd} = -\frac{d\theta}{d\omega}$$

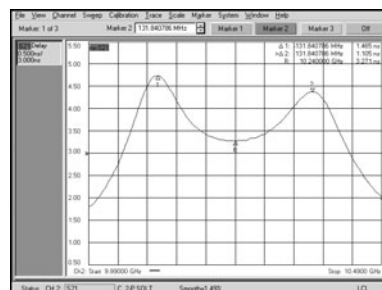


Figure 4: Direct measurement of group delay with digital readout at marker.

An alternative method for measuring phase distortion is deviation from linear phase or differential phase. Deviations from linear phase can be measured by introducing enough electrical length in the network analyzer's reference channel to linearize a device's phase shift. This is usually accomplished by using the electrical-delay feature of the network analyzer, which cancels the average electrical length of a device mathematically.

Scattering parameters, or S-parameters, were developed to characterize linear networks at high frequencies. S-parameters define the ratios of reflected and transmitted traveling waves measured at the network ports. A two-port device is modeled with S-parameters (see Figure 5). S_{11} is the complex reflection coefficient at port 1, and is

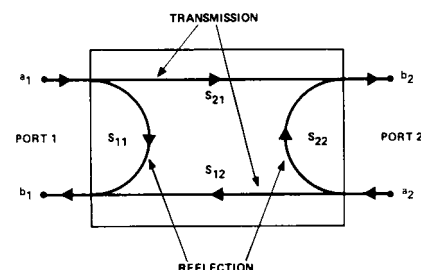


Figure 5: S-parameter model for a two-port linear network.

the ratio of b_1/a_1 , if $a_2 = 0$ (port 2 terminated in its characteristic impedance). S_{21} is the complex transmission coefficient from port 1 to port 2, b_2/a_1 , if $a_2 = 0$. The "a" and "b" signals represent the amplitude and phase of the incident and emerging or reflected traveling waves. By reversing the ports and terminating port 1 in its characteristic impedance, S_{22} and S_{12} can be similarly defined.

Additional Capabilities

Precision design work and manufacturing tolerances demand highly accurate measurements, but most errors in network measurements are complex quantities that vary as a function of frequency. By characterizing and virtually removing these systematic errors, measurement accuracies are improved by several orders of magnitude. Agilent network analyzers contain built-in, high-speed computational hardware that can perform the complex mathematics required for sophisticated error correction.

Computer-controlled network analyzers can be programmed to set up and make many measurements automatically. The measurement process is further accelerated by the computer's ability to store, transform, summarize, and output data in a variety of formats to a number of peripherals. These capabilities make the computer-controlled network analyzer ideal for both computer-aided design or automatic production testing. Several products have built-in automation features, including GP Instrument BASIC. The PNA family of network analyzers have an integrated Windows® operating system. This provides the user with powerful computer control directly in the network analyzer.

- Excellent measurement accuracy
- Fast, precise, integrated synthesized sources
- Choice of integrated S-parameter or T/R test sets
- Advanced automation and flexible options to boost capabilities



Tackle the Most Demanding Active and Passive Devices

From precision design work to high-volume manufacturing, component test manufacturers demand fast, accurate measurements. Agilent offers a host of RF and microwave vector network analyzers that are ready to tackle the most challenging active and passive networks, devices, components and subsystems.

Squeeze more performance from your designs with exceptional accuracy. Wide dynamic range and low trace noise make it easy to see the stopband and passband of even the highest-rejection filters.

On the production line, advanced productivity features such as automated pass/fail testing and segmented sweeps help accelerate test throughput. Built-in programming and connectivity capabilities increase the flexibility of your test systems, and can decrease the cost of test.

Selection Guide for Agilent Network Analyzers

	Frequency Range	Number of Ports	Balanced Measurements*	System Impedance	ECal Support	Measurement Speed (1 sweep, 201 points)
Vector E5100A	10 kHz to 300 MHz	2	No	50 ohm	No	8 ms (1-port cal, ramp-sweep) 64 ms (1-port cal, step-sweep)
Combination Network/Spectrum/Impedance 4395A, 4396B	10 Hz to 1.8 GHz	2	No	50 or 75 ohm	No	165 ms (response cal, gain, 30 kHz BW)
Vector – ENA-L E5061A, E5062A	300 kHz to 3 GHz	2	No	50 or 75 ohm	Yes	35 ms (2 port cal, 1 to 1.2 GHz, 30 kHz BW)
Vector – ENA E5071C	9 kHz to 8.5 GHz	2 or 4	Yes	50 ohm	Yes	8.8 ms (2 port cal, 1 to 1.2 GHz, 500 kHz BW)
Vector – PNA-L N5230A	300 kHz to 50 GHz	2 or 4	Yes	50 ohm	Yes	18 ms (2-port cal, 1 to 2 GHz, 600 kHz BW)
Vector – PNA E8362/3/4B, E8361A	10 MHz to 67 GHz	2	No	50 ohm	Yes	64 ms (2-port cal, 1 to 2 GHz, 35 kHz BW)
Vector – PNA-X N5242A	10 MHz to 26.5 GHz	2 or 4	Yes	50 ohm	Yes	35 ms (2-port cal, 1 to 2 GHz, 600 kHz BW)
Vector – PNA N5250A	10 MHz to 110 GHz	2	No	50 ohm		
Scalar 8757D	10 MHz to 110 GHz	2	No	50 ohm	No	470 ms (2-port cal, 10 kHz BW)

* Table shows the capabilities of the stand-alone instrument. For the PNA, it is possible to add balanced capability with an external test set.
Note: For the E5100A, 4395A and 4396B, number of ports denotes for the use with S-parameter test set or T/R test set.

The Agilent 8712ET, 8712ES, 8714ET, 8714ES RF network analyzers were discontinued on June 30, 2004. The Agilent 8719ET, 8719ES, 8720ET, 8720ES, 8722ET and 8722ES microwave network analyzers were discontinued on April 30, 2005. The Agilent 8753ET and 8753ES RF network analyzers were discontinued on October 31, 2006.

Agilent ENA-L, ENA, PNA-L, PNA-X and PNA Series of network analyzers are the recommended replacement products. ENA and PNA models offer fast and accurate RF component measurements for both R&D evaluations and production testing.

Recommended Replacement Products

Max Freq.	Discontinued Products	Suggested Replacement Family	T/R Test Set, 75 Ω	Multiport or Balanced/Differential	Frequency Offset Mode for Mixers, Harmonics and Intermodulation	Vector & Scalar Mixer Cal	Configurable Test Set	Pulsed RF or Antenna Test
1.5 GHz	8712ET/ES	300 kHz to 1.5 GHz ENA-L Series	E5061A					
3 GHz	E8356A E8801A N3381A 8753ET/ES 8714ET/ES	300 kHz to 3 GHz ENA-L Series or 9/100 kHz to 4.5 GHz ENA Series	E5062A	E5071C (Option 440 or 445)	E5071C (Option 008)	E5071C (Option 008)		
6 GHz	E8357A E8802A N3382A 8753ET/ES (Option 006)	9/100 kHz to 8.5 GHz ENA Series or 300 kHz to 6 GHz PNA-L Series		E5071C (Option 480 or 485)	E5071C (Option 008) N5230A (Option 020 or 025, & 080)	E5071C (Option 008)	N5230A (Option 025)	N5230A (Option 025)
9 GHz	E8358A E8803A N3383A	300 kHz to 13.5 GHz PNA-L Series			N5230A (Option 120 or 125, & 080)		N5230A (Option 125)	N5230A (Option 125)
13.5 GHz	8719ES 8719ET	300 kHz to 13.5 GHz PNA-L Series			N5230A (Option 120 or 125, & 080)		N5230A (Option 125)	N5230A (Option 125)
20 GHz 4-port	8720ES with Special Test Set	10 MHz to 26.5 GHz PNA-X Series		N5230A (Option 240 or 245)	N5230A (Option 240 or 245, & 080)		N5230A (Option 245)	
20/40 GHz	8720/22ES 8720/22ET	10 MHz to 26.5 GHz PNA-X Series			N5230A (Option 220 or 225, 420 or 425, 520 or 525, & 080)	E8362/3/4B (Option 014, UNL, 080, 081, 083)	N5230A (Option 225 or 425 or 525) E8362/3/4B (Option 014)	E8362/3/4B (Option 014, UNL, 080, 081, H11, H08)

ENA-L Series

The Agilent ENA-L Series network analyzers provide reliable, basic S-parameter measurements with easy-to-use features and solid performance based on the latest in modern technologies. The transmission/reflection (T/R) test set options offer lower cost solutions, while the S-parameter test set options provide more accurate measurements with full two-port calibration. 75-ohm options, as well as 50 ohm, are available for CATV component measurements.

- 300 kHz to 1.5 GHz – **E5061A**
- 300 kHz to 3 GHz – **E5062A**

ENA Series

The Agilent ENA Series network analyzers offer fast and accurate measurements for RF components. Built-in 2 and 4 test ports provide simultaneous measurement of all signal paths for components with up to four ports. The ENA Series provides built-in balanced measurement capability, which enables you to test balanced components such as, SAW filters and differential amplifiers. It provides mixed-mode S-parameter measurements with a fixture simulator function.

- 9/100 kHz to 4.5/8.5 GHz – **E5071C**

PNA-L Series

Agilent PNA-L network analyzers are designed for your general-purpose network analysis needs and priced for your budget. PNA-L provides efficiency and flexibility in both manufacturing and R&D applications for industries ranging from wireless LAN components to aerospace and defense.

- 300 kHz to 6 GHz – **N5230A (Option 020/025)**
- 300 kHz to 13.5 GHz – **N5230A (Option 120/125)**
- 300 kHz to 20 GHz 4-port – **N5230A (Option 240 or 245)**
- 10 MHz to 20 GHz – **N5230A (Option 220 or 225)**
- 10 MHz to 40 GHz – **N5230A (Option 420 or 425)**
- 10 MHz to 50 GHz – **N5230A (Option 520 or 525)**

PNA-X Series

The Agilent PNA-X is the premier-performance network analyzer for active device test. Exceptional performance, configurability, and an integrated second source enables engineers to stay on the leading edge of component testing.

- 10 MHz to 26.5 GHz – **N5242A**

PNA Series

The Agilent PNA Series microwave vector network analyzers offer an unsurpassed combination of speed and precision to meet the challenges of general-purpose, high-performance and millimeter-wave component testing from 10 MHz to 110 GHz. Frequency-offset capability for the PNA Series microwave network analyzer offers industry-leading accuracy and ease-of-use for non-linear measurements, including mixer and converter test, as well as amplifier IMD and harmonic measurement capability.

- 10 MHz to 20 GHz – **E8362B**
- 10 MHz to 40 GHz – **E8363B**
- 10 MHz to 50 GHz – **E8364B**
- 10 MHz to 67 GHz – **E8361A**
- 10 MHz to 110 GHz – **N5250A**

Key Literature & Web Link

www.agilent.com/find/nadisco

- **Wide dynamic range:** >123 dB
- **Low trace noise:** <0.004 dBrms at 70 kHz IFBW
- **Fast measurement speed:** 39 ms at full 2-port cal, 1601 points
- **Integrated 2, or 4 test ports**
- **Built-in balanced measurements**
- **Fixture embedding/de-embedding**
- **Mixer evaluation with advanced calibration**
- **Easy automation through USB**
- **LXI class C compliance**
- **4-port electronic calibration kit (ECal) support**
- **Built-in Microsoft Visual Basic for Applications (VBA)**
- **10.4-inch color LCD with touch screen**



E5071C ENA Series RF Network Analyzers

The Agilent E5071C ENA Series RF network analyzer is the ideal solution for manufacturing and R&D engineers evaluating RF components and circuits from 9 kHz to 8.5 GHz, featuring an integrated 2- or 4-port, the highest performance, extended lower frequency range and fastest speed in its class. The ENA Series significantly reduces cost of test through its ability to cover such a wide frequency range in a single instrument. The Agilent ENA series addresses a broad array of component and circuit tests including EMC-related applications and automotive, wireless communications, aerospace and defense, education, and medical applications.

De Facto Industry Standard RF Network Analyzer

The ENA series is a replacement for the legacy de facto industry standard: Agilent 8753 RF network analyzer. The lower-end frequency is 9 kHz without built-in bias tees and 100 kHz with built-in bias tees. Built-in bias tees and AUX inputs for DC measurements allow the ENA series to replace Agilent 8753 in DC-biased measurement applications and amplifier test applications, respectively. The built-in probe power also allows active probes to be used without an external probe power supply. In-circuit testing can be done using the high-impedance probe.

Excellent Measurement Accuracy and Speed

The ENA series provides exceptional performance with industry-leading dynamic range (123 dB), trace noise (0.004 dBrms at 70 kHz IFBW) and fast measurement speed (39 ms at 1601 points, 2-port full cal). The ENA's measurement capabilities enables the design of high performance components with a short cycle time.

Advanced Architecture for Multiport Component Test

Built-in 2, or 4 test ports provide simultaneous measurement of all signal paths for components. This advanced architecture minimizes the number of sweeps to complete a multiport S-parameter measurement and dramatically improves test throughput.

The ENA series holds up to 36 measurement channels in a single instrument state. Independent frequency list, calibration data, measurement parameters, trace layout, triggering, and limit test are applied in each measurement channel, which acts as if it is an independent network analyzer. This multi-channel capability eliminates recall time for sequencing multiple instrument setup states. Up to 36 display windows representing each measurement channel may be observed simultaneously. Within each window, it is possible to display up to 9 traces. The layout of display windows and traces are easily selected from the various preset states.

Integrated Balanced Measurement and Embedding/De-Embedding

The ENA series provides balanced conversion and delivers mixed mode S-parameter measurements with 4 test ports. This integrated measurement capability improves test efficiency of balanced components.

The matching circuit function (embedding) re-calculates measured data to simulate characteristics of components including matching circuits with arbitrary port characteristic impedance. The de-embedding function removes additional fixture characteristics from the measured data, enabling the measurement of a device's characteristics without the test fixture effects.

Advanced Mixer Measurement Capabilities

The ENA series offers the frequency-offset mode (FOM) that provides frequency-offset sweep, external signal source control, and fixed IF/RF measurement capabilities. In addition, the ENA FOM supports two mixer calibration techniques. The first technique is the vector-mixer calibration (VMC) that corrects for directivity, source match, load match, and reflection frequency response at each test port by using a characterized calibration mixer with de-embedding function. This calibration provides the most accurate measurements of phase and absolute group delay. The second is the scalar-mixer calibration (SMC) that offers the highest accuracy conversion loss/gain measurement results while correcting the mismatches of both input and output test ports.

Reducing Calibration Time Using ECal

The ENA series provides full 2- and 4-port calibration and improves measurement accuracy of multiport devices. The ENA series supports various electronic calibration kits (ECal), including the N4431B 4-port electronic calibration kit. The ECal automatically performs the calibration procedure and minimizes operational errors. The ECal module can be controlled by the ENA series via USB interface without an external PC. The front USB port is available for the ECal module and can easily connect to a rack mounted ENA. The ENA supports various ECal functions. After ECal calibration, performance can be verified using the ECal Confidence Check function. The User-Characterization ECal function enables calibration with various adapters attached, increasing your calibration flexibility.

Evolution of Test Automation, Built-In VBA

The ENA series accelerates test system development, expands customization capability and increases flexibility of test system integration. VBA is a powerful programming language that brings in a new era of test automation. A test program can be developed in the ENA Series by using the built-in VBA editor. This powerful programming tool helps you to accelerate test system development.

A custom user interface can be easily developed with the graphical programming features of the VBA. This allows the limit test results and instructions to be displayed and helps to avoid operational errors.

At times measurement parameters need to be calculated mathematically or processed statistically after data acquisition. The VBA is also useful for such post processing. Unique analysis functions are easily implemented using various VBA functions. This expands analysis capability of the test equipment and fully meets test needs.

E5071C

Network Analyzers

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ENA Series RF Network Analyzers (cont.)

Ease-of-Use

The ENA series employs conventional softkey-style operation, which enables users to quickly start using it without any intensive learning. The touch screen provides further enhancement for usability. The large 10.4-inch color display is very useful when looking at many traces for multiport measurements. For those who are familiar with a Windows® PC, the ENA series can also be controlled using Windows-style pull down menus. These easy-to-use features increase engineers' test efficiency.

Key Specifications

Test Frequency

9 kHz (without bias tees)/100 kHz (with bias tees) to 4.5 GHz/8.5 GHz

Test Port Output Power

–55 dBm to +10 dBm (65 dB power sweep range)

Number of Test Ports

2 or 4

IFBW

10 Hz to 500 kHz (1, 1.5, 2, 3, 4, 5, 7 step)

Channel/Trace Type

1/4, 2/4, 4/16, 9/9, 12/6, 16/4, 16/16, 24/12, 36/9

Number of Points

2 to 20,001 (with only 1 channel/4 traces mode. In other mode, maximum is 1,601)

System Dynamic Range

- 97 dB (9 kHz to 300 kHz at 10 Hz IFBW)
- 107 dB (300 kHz to 10 MHz at 10 Hz IFBW)
- 123 dB (10 MHz to 6 GHz at 10 Hz IFBW)
- 117 dB (6 GHz to 8.5 GHz at 10 Hz IFBW)

Trace Noise (magnitude)

- 0.004 dBrms (9 kHz to 30 kHz at 3 kHz IFBW)
- 0.003 dBrms (30 kHz to 10 MHz at 3 kHz IFBW)
- 0.004 dBrms (10 MHz to 4.38 GHz at 70 kHz IFBW)
- 0.006 dBrms (4.38 GHz to 8.5 GHz at 70 kHz IFBW)

Cycle Time

39 ms at full 2-port calibration, 1601 points, Start 1 GHz, Stop 1.2 GHz

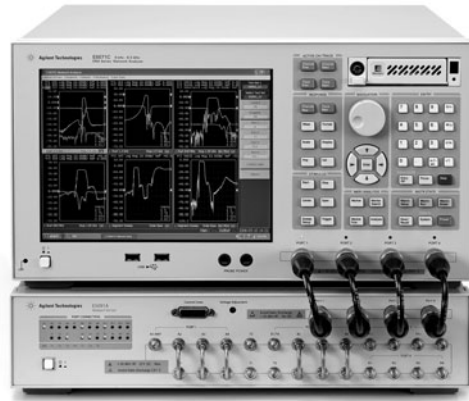
Stability (magnitude)

- ± 0.005 dB/°C (9 kHz to 3 GHz)
- ± 0.010 dB/°C (3 GHz to 6 GHz)
- ± 0.040 dB/°C (6 GHz to 8.5 GHz)

Ordering Information

E5071C Agilent ENA Network Analyzer

- E5071C-240** 2-port Test Set 9 kHz to 4.5 GHz, without Bias Tees
- E5071C-245** 2-port Test Set 100 kHz to 4.5 GHz, with Bias Tees
- E5071C-440** 4-port Test Set 9 kHz to 4.5 GHz, without Bias Tees
- E5071C-445** 4-port Test Set 100 kHz to 4.5 GHz, with Bias Tees
- E5071C-280** 2-port Test Set 9 kHz to 8.5 GHz, without Bias Tees
- E5071C-285** 2-port Test Set 100 kHz to 8.5 GHz, with Bias Tees
- E5071C-480** 4-port Test Set 9 kHz to 8.5 GHz, without Bias Tees
- E5071C-485** 4-port Test Set 100 kHz to 8.5 GHz, with Bias Tees
- E5071C-008** Frequency-offset Mode
- E5071C-010** Time Domain Analysis Capability
- E5071C-790** Measurement Wizard Assistant Software
- E5071C-1E5** High Stability Timebase



E5091A Multiport Test Set

The E5091A is a multiport test set used with the 4-port ENA Series network analyzer to expand the number of test ports up to 16. This is an ideal solution for testing antenna switch modules for mobile handsets, particularly those modules with balanced ports, although it can be used in a wide range of multiport measurement applications. The test set is available in 9- and 16-port configurations and is controlled as if it were a part of the analyzer rather than a separate test set.

With up to 36 channels, each of which can measure up to 36 measurement parameters, the ENA multiport test solution can measure all the measurement paths required for antenna switch module testing. The signal paths of each measurement channel can also be displayed to help identify complex connections to the device. These capabilities ensure a single connection, single set-up measurement that reduces test time.

Key Literature

ENA Series RF Network Analyzers Brochure, p/n 5989-5478EN
ENA Series RF Network Analyzers Data Sheet, p/n 5989-5479EN
ENA Series RF Network Analyzers Configuration Guide, p/n 5989-5480EN
Agilent Network Analyzer Selection Guide, p/n 5989-5481EN
Test Solutions for Multiport and Balanced Devices Selection Guide, p/n 5988-2461EN

Ordering information

E5091A Multiport Test Set

E5091A-009 9-port Test Set

E5091A-016 13/16-port Configurable Test Set

- 300 kHz to 1.5 GHz (E5061A) or 3 GHz (E5062A)
- T/R or S-parameter test set
- 50 Ω or 75 Ω system impedance
- 10.4-inch color LCD with touch screen
- Affordable, basic performance



E5062A ENA-L RF Network Analyzer

Providing the latest in modern technology and flexibility, the Agilent ENA-L network analyzers provide basic vector network analysis in a wide range of industries and applications such as wireless communication, cable TV, automotive, education, and more. Designed to reduce tune and test times, these analyzers provide increased throughput to improve your measurement productivity. The affordably priced ENA-L, equipped with the core functions of the industry-standard ENA, includes many easy-to-use features and is optimized for efficient measurements and high reliability.

Fundamental Performance with Versatile General-purpose Test Capabilities

The ENA-L, with its 120 dB dynamic range and 0.005 dB rms trace noise, provides the accuracy and speed required for many network measurement applications. The wide 30 kHz IF bandwidth (IFBW) and powerful digital processing provide unprecedented measurement speed. The S-parameter test set options offer full two-port calibration for optimum accuracy (Option 250 or 275).

A Variety of Sweep Functions for Effective Analysis

Power sweep and three types of frequency functions provide effective analysis to suit your application needs such as:

- Power sweep to analyze active devices such as amplifiers
- Linear sweep to evaluate narrow-band devices such as filters
- Log sweep to evaluate broadband devices such as cables
- Segment sweep allows you to tailor the sweep condition with up to 201 sweep segments

Optional Electronic Calibration (ECal) Drastically Simplifies Calibration

Unlike the traditional mechanical calibration technique, Agilent's ECal modules only require one set of connections to perform full two-port calibration (controlled through the front panel USB port). The ENA-L controls the ECal module to perform the entire calibration to provide:

- Faster calibration and reduced complexity
- Reduced chance of operator error
- Reduced wear on connectors

Specifications

Test Frequency

- 300 kHz to 1.5 GHz (E5061A)
- 300 kHz to 3 GHz (E5062A)

Test Set: T/R or S-parameter

Max Port Output Power: 10 dBm

Port Impedance: 50 or 75 Ω

IFBW: 10 Hz to 30 kHz (1, 3 step)

Number of Points: 2 to 1601

System Dynamic Range: 120 dB @ 10 Hz IFBW (300 kHz to 3 GHz)

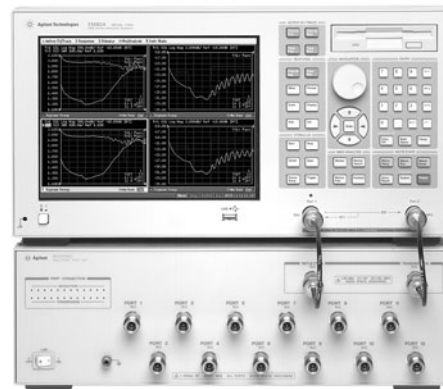
Trace Noise (magnitude): 0.005 dBrms @ 3 kHz IFBW (1 MHz to 3 GHz)

Accessories

87075C 75 Ω Multiport Test Set

The ENA-L, with the 87075C 75 Ω multiport test set, provides an ideal solution for multiport CATV component measurement. The test system offers fast measurement speed, high accuracy, and productivity features to maximize your production throughput.

- Specified performance to 1.3 GHz
- 6 or 12 test ports
- Test set calibration technique eliminates redundant connection of calibration standards, and ECal further reduces the number of connections
- Self calibration (an internally automated calibration technique) reduces the effects of test system drift

E5062A ENA-L with 87075C 75 Ω Multiport Test Set

Key Literature

ENA-L Product Brochure, p/n 5989-0167EN
 ENA-L Data Sheet, p/n 5989-0018EN
 ENA-L Configuration Guide, p/n 5989-0170EN
 87075C Technical Overview, p/n 5989-0767EN

Ordering Information

E5061A 300 kHz to 1.5 GHz Network Analyzer

E5062A 300 kHz to 3 GHz Network Analyzer

E506xA-150 TR Test Set 50 ohm System Impedance

E506xA-175 TR Test Set 75 ohm System Impedance

E506xA-250 S-parameter Test Set 50 ohm System Impedance with Extended Power Range

E506xA-275 S-parameter Test Set 75 ohm System Impedance with Extended Power Range

E506xA-1E1 Extended Power Range (–45 to 10 dBm)

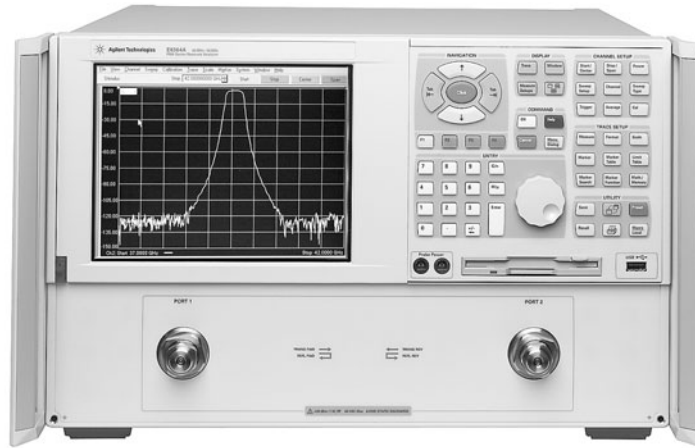
E506xA-100 Add Fault Location and SRL Analysis

E506xA-016 Touch Screen Color LCD

E8362/3/4B
E8361A
N5230A
N5242A
N5250A

- Frequency coverage from 300 kHz to 110 GHz
- Highest performance and broadest range of measurement applications

- Electronic calibration (ECal) to 67 GHz
- Open Windows XP operating system



Rapid and continuous changes in RF, microwave, and millimeter-wave technology present a growing challenge for component designers and manufacturers. The Agilent PNA, PNA-X and PNA-L Series of microwave vector network analyzers provides a powerful and flexible measurement platform that meets the challenge with the right combination of high accuracy, fast sweep speeds, wide dynamic range, low trace noise, and enhanced connectivity. The PNA, PNA-X and PNA-L Series will meet your measurement needs now and well into the future.

Common Features

- Electronic calibration for fast, accurate, and convenient system-error correction
- TRL/LRM calibrations for high accuracy fixture and on-wafer measurements
- Configurable test set for a wide variety of measurement setups
- Frequency offset mode for mixer and amplifier-distortion tests
- Time-domain analysis for improved accuracy and filter tuning
- Easy-to-use front-panel hardkey/softkey interface, or use a mouse and pull-down menus
- Extensive built-in help system for quick answers to operation, application, and programming questions
- Open Windows® operating systems for advanced automation and easy connection of peripherals

Advanced Connectivity

The PNA family offers many methods of communication to and from the instrument, using a variety of built-in I/O interfaces. Windows XP lets you take advantage of many features you take for granted on your PC, helping you attain a new level of integration for your component-test processes.

For local storage, use the analyzer's internal hard disk drive or connect a USB-based hard disk, flash, or CD-R/W drive. In addition, using drive mapping and the LAN interface, you can save data directly to remote PCs or file servers. This arrangement makes it very easy to develop statistical- process-controlled manufacturing environments.

The PNA family allows a number of ways to connect and control other test equipment such as power meters and signal sources. You can choose to connect them via the USB, GPIB, LAN, serial, or parallel interfaces, and, using any Windows-compatible test program, you can control the test equipment directly from the analyzer. The LAN interface also makes it easy to perform remote troubleshooting. You can view measurement results and control the analyzer from anywhere on the network, whether you are on another floor, in another building, or even at a different site. Additionally, you can download firmware and help-file updates from our web site: www.agilent.com/find/pna

Automation

For manufacturing environments, test automation is essential for high throughput. For R&D, automated tests can save considerable time that might be spent on repetitive and tedious measurements. The PNA family lets you automate your test processes using several powerful automation approaches. You can create programs using familiar SCPI commands via the GPIB or LAN interfaces, or use COM commands over LAN for fast analyzer access and data transfer. Test programs can be executed internally on the PNA or externally on your PC.

Flexibility

In addition to the measurement-hardware flexibility that is achievable using the configurable test set, the PNA's firmware offers unparalleled measurement flexibility as well:

- Configure up to 32 independent measurement channels to eliminate the need for multiple instrument-states recalls
- Use up to 16,001 data points per measurement channel
- Display up to 16 windows, with 4 active traces in each window
- Select up to 10 coupled or independent markers per trace

E8362/3/4B
E8361A
N5230A
N5242A
N5250A

Throughput

Decreasing test time is often critical for success in manufacturing environments. The PNA family has many attributes that help you accomplish your throughput goals. The outstanding performance of the analyzers starts with exceptionally fast sweeps that do not sacrifice performance. Features such as segmented sweeps and limit lines for pass/fail testing allow you to optimize test efficiency. For devices that once required two to four instrument setups for complete characterization, the PNA Series' ability to have up to thirty-two-measurement channels, each with its own stimulus and response parameters, can also improve your test throughput.

When using Agilent's electronic calibration (ECal) modules, you can dramatically reduce the time it takes to perform calibrations, so you can spend more time measuring your devices. Simply connect the ECal module to your test ports and let the analyzer control and measure all the standards necessary for full two-port calibration. These modules are controlled directly from the analyzer via a USB connection.

PNA-X

The PNA-X is the premier-performance network analyzer for active device test. Exceptional performance, configurability and an integrated second source enable engineers to stay on the leading-edge of component testing.

Key Features

- 2 or 4 port 10 MHz to 26.5 GHz
- Excellent source output power and harmonic performance
- Built-in signal combiner for IMD measurements
- Built-in pulse generators and modulators for pulse RF measurements
- Banded mm-wave systems to 325 GHz
- Compatible with multiport test sets
- Mixed/converter test with advanced calibrations
- Antenna/RCS test

PNA-L Series

The PNA-L Series is a cost-effective solution for general-purpose network-analysis needs. The PNA-L offers the perfect balance of value and performance.

Key Features

- 2-port 300 kHz to 6, 13.5 GHz
- 2-port 10 MHz to 20, 40, 50 GHz
- 4-port 300 kHz to 20 GHz, with mixed-mode S-parameters and advanced fixture corrections
- Frequency and power sweeps for measuring S-parameters and gain compression
- Basic mixer/converter measurements
- Pulsed-RF testing down to 2 μ s pulse widths

PNA Series

The PNA Series provides advanced performance and measurement capabilities, and is specifically designed for more-demanding applications such as high-accuracy mixer/converter test including absolute group delay, and antenna, pulsed-RF, and mm-wave measurements.

Key Features

- 2-port 10 MHz to 20, 40, 50, 67, 110 GHz
- Banded mm-wave systems to 325 GHz
- Multiport test sets to 67 GHz
- Mixer/converter test with advanced calibrations
- Antenna/RCS test
- Pulsed-RF testing down to 50 ns pulse widths

Network Analyzers

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PNA Series MW Network Analyzers

MW PNA and PNA-X Series

Model	E8362/63/64B	E8361A	N5250A	N5242A
Frequency Range	10 MHz to 20/40/50 GHz	10 MHz to 67 GHz	10 MHz to 110 GHz ¹	10 MHz to 26.5 GHz
Number of Ports	2	2	2	2 or 4
Connector Type (male)	3.5/2.4/2.4 mm	1.85 mm	1.0 mm	3.5 mm
Dynamic Range (at test port)²				
10 to 45 MHz	79 dB	61 dB	63 dB	93 dB
45 MHz to 2 GHz	94 to 119 dB	87 to 111 dB	94 to 120 dB	93 to 124 dB
2 to 20 GHz	122 dB	111 dB	111 dB	127 dB
20 to 40 GHz	110 dB	104 dB	42 dB	—
40 to 50 GHz	104 dB	96 dB	84 dB	—
50 to 60 GHz	—	97 dB	80 dB	—
60 to 70 GHz	—	94 dB	68 dB	—
70 to 75 GHz	—	—	74 dB	—
75 to 80 GHz	—	—	85 dB	—
80 to 110 GHz	—	—	87 dB	—
Dynamic Range (receiver access)²				
10 to 45 MHz	129 dB	99 dB	—	128 dB
45 MHz to 2 GHz	132 dB	102 to 125 dB	—	115 to 136 dB
2 to 20 GHz	136 dB	125 dB	—	136 dB
20 to 40 GHz	119 dB	115 dB	—	—
40 to 50 GHz	111 dB	109 dB	—	—
50 to 60 GHz	—	107 dB	—	—
60 to 70 GHz	—	100 dB	—	—
Trace Noise (1 kHz IF BW)³				
500 MHz to 50 GHz	<0.006 dB rms <0.1 deg rms	<0.006 dB rms <0.1 deg rms	—	<0.003 dB rms <0.05 deg rms
Maximum Output Power²				
10 to 45 MHz	+2 dBm	-9 dBm	-8 dBm	+8 dBm
45 MHz to 10 GHz	+5 dBm	-3 dBm	-3 dBm	+10 to 13 dBm
10 to 20 GHz	+3 dBm	-2 dBm	-5 dBm	+13 dBm
20 to 40 GHz	-4 dBm	-2 dBm	-10 dBm	+13 to 12 dBm ⁸
40 to 45 GHz	-5 dBm	-7 dBm	-15 dBm	—
45 to 50 GHz	-10 dBm	-1 dBm	-12 dBm	—
50 to 60 GHz	—	-3 dBm	-17 dBm	—
60 to 70 GHz	—	-5 dBm	-22 dBm	—
70 to 110 GHz	—	—	-8 dBm	—

Full Band Measurement Speed (35 kHz IF bandwidth, 201 points; 100 kHz for N5242A)

Model	Frequency	Cycle Time (ms) ³	µs/Point	Updates/Second
E8362B	10 MHz to 20 GHz	126	627	8
E8363B	10 MHz to 40 GHz	185	920	6
E8364B	10 MHz to 50 GHz	210	1045	5
E8361A	10 MHz to 67 GHz	244	1214	4
N5242A	10 MHz to 26.5 GHz	75	373	13
N5250A ⁵	10 MHz to 110 GHz	500	2488	2

Data Transfer Speed, 32-bit binary (ms)⁴

	201 points	16,001 points
COM ⁶	0.4	2
SCPI ⁶	1	30
DCOM ⁷	0.8	7
SCPI over GPIB ⁷	7	435

¹ The PNA can also be configured with waveguide mm-wave heads for banded solutions up to 325 GHz.

² Typical performance below 45 MHz and above 67 GHz. All N5250A numbers are typical.

³ Typical performance includes retrace and band-switching times with response calibration. Two-port calibration approximately doubles cycle time.

⁴ Typical performance.

⁵ 10 kHz IF bandwidth.

⁶ Program executed in PNA.

⁷ Program executed on an external PC.

⁸ Power 24 to 26.5 GHz = +5 dBm.

Key Specifications

Option	020, 025	120, 125	220, 225	240, 245	420, 425	520, 525
Frequency Range	300 kHz to 6 GHz	300 kHz to 13.5 GHz	10 MHz to 20 GHz	300 kHz to 20 GHz	10 MHz to 40 GHz	10 MHz to 50 GHz
Number of Ports	2	2	2	4	2	2
Connector Type (male)	3.5 mm	3.5 mm	3.5 mm	3.5 mm	2.4 mm	2.4 mm

Dynamic Range, Two-port Models (at test port), dB

Option	020	120	220	420	520
300 kHz to 1 MHz	103	103	—	—	—
1 MHz to 10 MHz	113	113	—	—	—
10 MHz to 45 MHz	122	122	103 ¹	89 ¹	89 ¹
45 MHz to 500 MHz	122	122	105	90	90
500 MHz to 2 GHz	122	122	110	110	110
2 GHz to 6 GHz	122	122	110	110	110
6 GHz to 8 GHz	—	120	110	110	110
8 GHz to 9 GHz	—	120	110	100	100
9 GHz to 10.5 GHz	—	116	110	100	100
10.5 GHz to 12.5 GHz	—	111	110	100	100
12.5 GHz to 13.5 GHz	—	109	108	100	100
13.5 GHz to 20 GHz	—	—	108	100	100
20 GHz to 31.25 GHz	—	—	—	95	95
31.25 GHz to 40 GHz	—	—	—	90	90
40 GHz to 50 GHz	—	—	—	—	79

Dynamic Range, Four-port Model (at test port), dB

Option	240
300 kHz to 10 MHz	111 ¹
10 MHz to 4 GHz	120
4 GHz to 6 GHz	118
6 GHz to 10.5 GHz	115
10.5 GHz to 15 GHz	107
15 GHz to 20 GHz	103

Trace Noise (1 kHz BW), dB rms

Option	020	120	220	240	420	520
300 kHz to 10 MHz	0.012	0.012	—	0.015 ¹	—	—
10 MHz to 45 MHz	0.004	0.004	0.004 ¹	0.006	0.015 ¹	0.015 ¹
45 MHz to 6 GHz	0.004	0.004	0.006	0.001	0.010	0.010
6 GHz to 13.5 GHz	—	0.004	0.006	0.001	0.010	0.010
13.5 GHz to 20 GHz	—	—	0.006	0.001	0.010	0.010
20 GHz to 40 GHz	—	—	—	—	0.020	0.020
40 GHz to 50 GHz	—	—	—	—	—	0.020

Trace Noise (1 kHz BW), deg rms

Option	020	120	220	240	420	520
300 kHz to 10 MHz	0.080	0.080	—	0.110 ¹	—	—
10 MHz to 45 MHz	0.030	0.030	0.025 ¹	0.025	0.100 ¹	0.100 ¹
45 MHz to 6 GHz	0.030	0.030	0.060	0.025	0.060	0.060
6 GHz to 13.5 GHz	—	0.060	0.060	0.050	0.100	0.100
13.5 GHz to 20 GHz	—	—	0.060	0.050	0.100	0.100
20 GHz to 40 GHz	—	—	—	—	0.200	0.200
40 GHz to 50 GHz	—	—	—	—	—	0.200

Maximum Leveled Output Power, dBm

Option	020	120	220	240	420	520
300 kHz to 10 MHz	10	10	—	8 ¹	—	—
10 MHz to 45 MHz	10	10	—	8	—	—
45 MHz to 6 GHz	10	10	5	6	0	0
6 GHz to 9 GHz	—	8	5	3	0	0
9 GHz to 13.5 GHz	—	2	3	0	0	0
13.5 GHz to 20 GHz	—	—	3	–3	0	0
20 GHz to 40 GHz	—	—	—	—	–5	–5
40 GHz to 50 GHz	—	—	—	—	—	–11

Measurement Speed

Broadband sweep (10 MHz to 10 GHz, 50 kHz IF bandwidth, 201 points, no calibration): 97 ms²

Narrowband sweep, Options 020, 025, 120, 125, 240, 245 (9.95 GHz to 10.05 GHz, 600 kHz IF bandwidth, 201 points, no calibration): 7 ms³

Narrowband sweep, Options 220, 225, 420, 425, 520, 525 (9.95 GHz to 10.05 GHz, 250 kHz IF bandwidth, 201 points, no calibration): 9 ms³

Data Transfer Speed, 32-bit Binary (ms)¹

	201 points	1601 points
COM ⁴	0.4	2
SCPI (internal) ⁴	1	30
DCOM ⁵	0.8	7
SCPI over GPIB ⁵	7	435

¹ Typical.

² Includes sweep, band-cross, and retrace time.

³ Includes sweep and retrace time.

⁴ Program executed in the PNA.

⁵ Program executed on an external PC.

Network Analyzers

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PNA Series MW Network Analyzers

PNA Network Analyzers¹

E8361A/62B/63B/64B, N5250A

PNA (high performance series)

E8362B 10 MHz to 20 GHz

E8363B 10 MHz to 40 GHz

E8364B 10 MHz to 50 GHz

E8361A 10 MHz to 67 GHz

N5250A² 10 MHz to 110 GHz

Options

To add options to a product, order the corresponding item number.

	Description	For E8362B	For E8363B	For E8364B	For E8361A	For N5250A System ³	Additional Information
Test Set							
Option 014	Configurable test set	E8362B-014	E8363B-014	E8364B-014	E8361A-014	Included	—
Power Configuration							
Option UNL	Extended power range and bias-tees	E8362B-UNL	E8364B-UNL	E8364B-UNL	E8361A-UNL	Included	Only E8361A requires 014
Option 016	Add receiver attenuators	E8362A-016	E8364A-016	E8364A-016	E8361A-016	E8361A-016	Requires UNL (only E8361A also requires 014)
Option H85	High-power configuration	E8362B-H85	H8363B-H85	H8364B-H85	Contact Agilent	Contact Agilent	Includes 014, 016, UNL ⁴
Non-linear Measurements							
Option 080	Frequency offset	E8362A-080	E8364A-080	E8364A-080	E8361A-080	Included	Requires 014 (E8361A only, 081 required if UNL is also purchased)
Option 081	Reference receiver switch	E8362A-081	E8364A-081	E8364A-081	E8361A-081	Included	Requires 014, 080 (only E8361A also requires UNL)
Option 082 ⁵	Scalar-calibrated converter measurements	E8362A-082	E8364A-082	E8364A-082	E8361A-082	Included	—
Option 083	Vector and Scalar-calibrated converter measurements	E8362A-083	E8364A-083	E8364A-083	E8361A-083	E8361B-083	Requires 014, 080, 081 (only E8361A also requires UNL, includes GPIB to USB interface (82357A))
Pulse, Antenna, mm-wave							
Option H08 ⁶	Pulsed-RF measurement capability	E8362B-H08	E8363B-H08	E8364B-H08	E8361A-H08	E8361A-H08	—
Option H11	IF access (for antenna, pulsed-RF and mm-wave measurements)	E8362B-H11	E8363B-H11	E8364B-H11	E8361A-H11	Included	Requires 014, UNL, pulsed-RF and mm-wave 080, and 081
Measurement Features							
Option 010	Time-domain capability	E8362A-010	E8363A-010	E8364A-010	E8361A-010	E8361B-010	—
Accessories							
Option 1CM	Rack mount kit for use without handles	E8362A-1CM	E8363A-1CM	E8364A-1CM	E8361A-1CM	E8361A-1CM	—
Option 1CP	Rack mount kit for use with handles	E8362A-1CP	E8363A-1CP	E8364A-1CP	E8361A-1CP	E8361A-1CP	—
N4688A	USB CD R/W drive	N4688A	N4688A	N4688A	N4688A	N4688A	—
N4689A	USB Hub	N4689A	N4689A	N4689A	N4689A	N4689A	—
Calibration Documentation							
Option 1A7	ISO 17025 compliant calibration	E8362B-1A7	E8363B-1A7	E8364B-1A7	E8361A-1A7	E8361A-1A7	—
Option UK6	Commercial calibration certificate with test data	E8362A-UK6	E8363A-UK6	E8364A-UK6	E8361A-UK6	E8361A-UK6	—
Option A6J	ANSI Z540 compliant calibration	E8362B-A6J	E8363B-A6J	E8364B-A6J	E8361A-A6J	E8361A-A6J	—

Note: Item numbers may not correspond to product model number. For example, to order the time-domain option on the E8362B, the correct item number to order is E8362A-010.

Warranty and Service

One and three-year warranty and service plans are available at time of instrument purchase. The N5250A 110 GHz system carries a full one-year on-site warranty (where available).

Key Literature & Web Link

PNA Series Brochure, p/n 5989-6014EN

PNA Series Technical Specifications, p/n 5988-7988EN

PNA Series Configuration Guide, p/n 5988-7989EN

PNA Millimeter-Wave Network Analyzers Technical Overview, p/n 5988-9620EN

For more information, visit our web site:

www.agilent.com/find/pna

Calibration

Three and five year calibration plans are available at time of instrument purchase.

¹ All models are not available in all countries.

² For more detailed information regarding the 110 GHz network analyzer system, refer to the Agilent Web site: www.agilent.com/find/pna and download the N5250A Technical Overview, p/n 5988-9620EN.

³ The N5250A 110 GHz system also includes an N5260A millimeter-wave test set controller, 1.0 mm combiner assembly, interconnecting cables, and installation and productivity assistance.

⁴ UNL does not include bias tees. Only includes source attenuators.

⁵ Up to 67 GHz.

⁶ Option 082 is a subset of Option 083, and therefore, they cannot be ordered together.

PNA-X Network Analyzers N5242A , 10 MHz to 26.5 GHz, 2 or 4 Ports

N5242A

Options

To add options to a product, order the corresponding item number.

	Description	For N5242A	Additional information
Test Set			
Option 200	2 ports, single source	N5242A-200	
Option 224	2 ports, add internal 2nd source, combiner and mechanical switches	N5242A-224	Requires Options 200, 219, and 080 Recommends Option 080
Option 400	4 ports, dual source	N5242A-400	
Option 423	4 ports, add internal combiner and mechanical switches	N5242A-423	Requires Options 400, 419, and 080
Power Configuration			
Option 219	2 ports, extended power range and bias-tees	N5242A-219	Requires Option 200
Option 419	4 ports, extended power range and bias-tees	N5242A-419	Requires Option 400
Non-linear Measurements			
Option 080	Frequency offset	N5242A-080	
Option 082 ¹	Scalar-calibrated converter measurements	N5242A-082	Requires Option 080
Option 083 ¹	Vector and scalar-calibrated converter measurements	N5242A-083	Requires Option 080
Pulse, Antenna, mm-wave			
Option H08	Pulse measurements	N5242A-H08	
Option 020	Add IF inputs for antenna and mm-wave	N5242A-020	
Option 021	Add pulse modulator to internal 1st source	N5242A-021	Requires Options 224 or 400
Option 022	Add pulse modulator to internal 2nd source	N5242A-022	
Option 025	Add four internal pulse generators	N5242A-025	
Measurement Features			
Option 010	Time-domain measurements	N5242A-010	
Accessories			
Option 1CM	Rack mount kit for use without handles	N5242A-1CM	
Option 1CP	Rack mount kit for use with handles	N5242A-1CP	
N1966A	Pulse I/O adapter	N1966A	
N4688A	USB CD R/W drive	N4688A	
N4689A	USB Hub	N4689A	
Calibration Software			
Option 897 ²	Perpetual license for built-in performance test software for Agilent inclusive calibration	N5242A-897	
Option 898 ²	Perpetual license for built-in performance test software for standards compliant calibration	N5242A-898	
Calibration Documentation			
Option 1A7	ISO 17025 compliant calibration	N5242A-1A7	
Option UK6	Commercial calibration certificate with test data	N5242A-UK6	
Option A6J	ANSI Z540 compliant calibration	N5242A-A6J	

¹ Option 082 is a subset of Option 083, and therefore, they can not be ordered together.

² Additional hardware required. Please refer to chapter 2 of the Service Guide for required service test equipment.

Key Literature & Web Link

PNA Series Brochure, p/n 5989-6014EN

PNA Series Technical Specifications, p/n 5988-7988EN

PNA Series Configuration Guide, p/n 5988-7989EN

PNA Millimeter-Wave Network Analyzers Technical Overview,
p/n 5988-9620EN

For more information, visit our web site:

www.agilent.com/find/pna

PNA-L (N5230A)

Ordering Guide for PNA-L Series Network Analyzers

This guide is intended to assist you in the ordering process. Additional information and products (such as calibration kits and cables) can be found in the PNA Configuration Guide (see Key Literature below).

Step 1: Select N5230A Model Number

Step 2: Choose your Frequency Range and Test Set (Mandatory, choose only one)

Description	Ordering Number
300 kHz to 6 GHz	2-port standard test set
300 kHz to 6 GHz	2-port configurable test set and extended power range
300 kHz to 13.5 GHz	2-port standard test set
300 kHz to 13.5 GHz	2-port configurable test set and extended power range
10 MHz to 20 GHz	2-port standard test set
10 MHz to 20 GHz	2-port configurable test set and extended power range
300 kHz to 20 GHz	4-port standard test set
300 kHz to 20 GHz	4-port configurable test set and extended power range
10 MHz to 40 GHz	2-port standard test set
10 MHz to 40 GHz	2-port configurable test set and extended power range
10 MHz to 50 GHz	2-port standard test set
10 MHz to 50 GHz	2-port configurable test set and extended power range

Step 3: Choose Additional Software Options (Optional)

Description	Ordering Number
Time domain for 6 GHz model	N52310-010
Time domain for 13.5, 20, 40 or 50 GHz model	N52300-010
Frequency-offset measurements	N52300-080

Step 4: Choose an Electronic or Mechanical Calibration Kit (Optional)

Description	Ordering Number
300 kHz to 13.5 GHz, 4-port, Type-N or 3.5 mm connectors	N4431B
300 kHz to 26.5 GHz, 2-port 3.5 mm connectors	N4691B
10 MHz to 50 GHz, 2-port 2.4 mm connectors	N4693A

Step 5: Accessories (Optional)

Description	Ordering Number
Rack mount kit without handle	Option 1CM
Rack mount kit with handles	Option 1CP
USB CD R/W drive	N4688A
USB Hub	N4689A

Step 6: Calibration Documentation (Optional)

Description	Ordering Number
ISO 17025 compliant calibration	Option 1A7
Commercial calibration certificate with test data	Option UK6
ANSI Z540 compliant calibration	Option A6J

Step 7: Choose your Warranty and Service (Optional)

Description
1-year return-to Agilent warranty and service
3-year return-to Agilent warranty and service

Key Literature & Web Link

2-port PNA-L Brochure, p/n 5989-0168EN
2-port PNA-L Data Sheet, p/n 5989-0514EN
4-port PNA-L Brochure, p/n 5989-0896EN
4-port PNA-L Data Sheet, p/n 5989-1695EN
PNA Series Configuration Guide, p/n 5988-7989EN

For more information, visit our web site:

www.agilent.com/find/pnal

Note: For additional calibration kits and accessories refer to the Configuration Guide.

- 10 kHz to 300 MHz
- 0.04 ms/point measurement speed
- Fine resolution IFBW
- List sweep function
- Stable measurements
- High-speed evaluation using the waveform analysis commands
- Evaporation Monitoring Function
- Phase Tracking Function
- Supports active probes (Option)
- GP Instrument BASIC for easy automation

E5100A Network Analyzers

The E5100A network analyzer is a 10 kHz to 300 MHz network analyzer best fitted for production lines of electronic component manufacturers, especially resonator and filter manufacturers, who require extra-high throughput.

The E5100A improves production line productivity with its fast measurement speed (fastest sweep speed is 0.04 ms/point), fast waveform analysis commands, and speedier processor. It provides faster measurements with lower fluctuations because of its low-noise performance and fine selection IFBW.

High-Quality and High-Speed Tests

The E5100A is a versatile network analyzer with many functions and options to fit your needs with a minimum investment. During final tests, both precision and high speed are required for better yield and better productivity. The E5100A makes high-quality and high-speed tests with its fine IFBW selection and low-noise circuitry. Its convenient analysis and processing functions improve the productivity of the final test processes.

Specifications

Source Characteristics

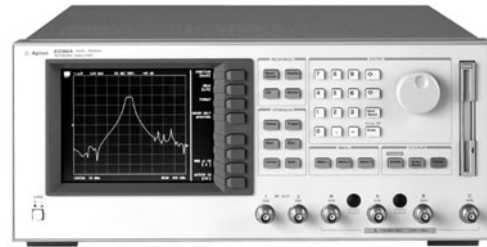
	Option 000	Option 600
Frequency Range	10 kHz to 300 MHz	10 kHz to 300 MHz
Number of RF Output Port	1	2 (Power Splitter inside)
Power Range	−48 to +22 dBm	−52 to +18 dBm (OUT 1) −65 to +5 dBm (OUT 2)
Power Resolution	0.1 dB	0.1 dB
Probe Power Supply	Installed	None

Receiver Characteristics

	Option 000	Option 600
Frequency Range	10 kHz to 300 MHz	10 kHz to 300 MHz
IFBW	10 Hz to 30 kHz (1, 1.5, 2, 3, 4, 5, 8 steps)	10 Hz to 30 kHz (1, 1.5, 2, 3, 4, 5, 8 steps)
Number of Ports	4	2
System Dynamic Range at Test Port	>120 dB (IFBW = 1 kHz)	>120 dB (IFBW = 1 kHz)
Dynamic Accuracy	±0.05 dB, ±0.3 deg	±0.05 dB, ±0.3 deg
Input Impedance (nominal)	50 Ω	50 Ω
Measurement Speed	0.04 ms/point (IFBW = 30 kHz, ramp-sweep)	0.04 ms/point (IFBW = 30 kHz, ramp-sweep)
Phase Tracking DLD Function	Installed	Installed
Evaporation Monitor Function	Installed	Installed

General Characteristics

Measurement Parameters: Gain (Amplitude Ratio), Phase, Group-Delay, Amplitude, Gain-Phase, Gain-Delay, Impedance, Admittance
Display: 6.5 inch TFT Color LCD
Programming: IBASIC



E5100A

Mass Storage: FDD and internal non-volatile memory
Parallel I/O Port: TTL, 16-bit output, 8-bit input/output (standard)
Power Requirement: 90 to 132 V or 198 to 264 V, 47 to 63 Hz, 400 VA max.
Size: 177 mm H x 425 mm W x 425 mm D (7.08 in x 17 in x 17 in)
Weight: 12 kg (26.4 lb) (typical)

Accessories

41901A SMD PI-Network Test Fixture

The 41901A SMD PI-network test fixture produces the capability to measure surface-mount crystal resonator using the E5100A. Attachment kit (option) is required for measurement. The frequency range of the 41901A is 1 MHz to 300 MHz.



Key Literature

E5100A Network Analyzer Product Overview, p/n 5968-1873E
E5100A Technical Specifications, p/n 5966-2888E

Ordering Information

E5100A Network Analyzer

E5100A-000 300 MHz 4-Receivers Standard Test Set (with mandatory options 801, 400, 706 and 804)
E5100A-600 300 MHz 2-Receivers X'tal Resonator Test w/PI-network (incompatible with E5100A-801, 400 and 706)
E5100A-801 Power Extended One RF OUT Port
E5100A-400 300 MHz 4-Receivers with Ports R, A, B and C
E5100A-706 Type-N 50 Ω Input Connector on Ports A and B
E5100A-804 Parallel I/O Standard
E5100A-006 Parallel I/O Mode B
E5100A-800 Standard Frequency Reference
E5100A-1D5 High Stability Frequency Reference
E5100A-1F0 PC Style Keyboard – U.S Version
E5100A-1CM Rackmount Kit
E5100A-1CN Handle Kit
E5100A-1CP Rackmount and Handle Kit
E5100A-ABA English Localization
E5100A-ABJ Japanese Localization

Accessories

41800A Active Probe
41802A 1 MΩ Input Adapter
41901A SMD PI-Network Test Fixture
41901A-010 to 41901A-061 Attachment Kit
11667A 50 Ω Power Splitter
87512A Transmission/Reflection Test Kit

Network/Spectrum Analyzers

164

Baseband, IF Network/Spectrum/Impedance Analyzer, 10 Hz to 500 MHz/10 Hz to 500 MHz/100 kHz to 500 MHz

4395A

- Full-vector network and spectrum measurement and analysis
- Wide dynamic range network measurement with fast sweep speeds
- ± 0.05 dB/ $\pm 0.3^\circ$ dynamic magnitude/phase accuracy
- Extremely fast narrowband spectrum measurement
- Impedance analysis option and test kit available
- -145 dBm/Hz sensitivity for spectrum analysis
- Built-in IBASIC for easy test automation
- Time-gated spectrum analysis option
- Color TFT display and built-in disk drive/RAM disk



4395A with 87511A

4395A Network/Spectrum/Impedance Analyzer

The 4395A provides excellent vector network, spectrum and optional impedance measurements for audio, baseband, HF, VHF, and IF applications. When combined with a test set, the 4395A provides reflection measurements, such as return loss, and SWR, and S parameters. Gain, phase, group delay, distortion, spurious, CN ratio, and noise measurements often required for evaluating components and circuits can be measured using one instrument. As a vector network analyzer, the 4395A operates from 10 Hz to 500 MHz with 1 mHz resolution and its integrated synthesized source provides -50 to $+15$ dBm of output power with 0.1 dB resolution. The dynamic magnitude and phase accuracy are ± 0.05 dB and $\pm 0.3^\circ$ so that it can accurately measure gain and group delay flatness, which are becoming more important in modern electronics systems.

As a spectrum analyzer, the 4395A operates from 10 Hz to 500 MHz with resolution bandwidths (RBWs) spanning 1 Hz to 1 MHz in a 1-3-10 steps. A fully-synthesized local oscillator allows stable and accurate frequency analysis. Direct A/D conversion (no LOG amplifier is used) results in ± 0.8 dB level accuracy (@ 50 MHz, -20 dBm). Noise sidebands fall below -110 dBc/Hz @ 100 kHz offset from carriers, while sensitivity is -145 dBm/Hz at 10 MHz.

Extremely Fast Spectrum Measurement

The 4395A features Fast Fourier Transform (FFT) digital-signal-processing (DSP) technique for 20 to 100 times faster narrowband spectrum measurement than swept-tuned spectrum analyzers. The stepped FFT is performed for all RBW settings. For example, with 100 Hz RBW and 100 kHz span, the 4395A has a sweep time of 300 ms, while swept-tuned spectrum analyzers take a few tens of seconds. The stepped FFT can greatly improve the efficiency of narrowband spectrum measurement.

Time-Gated Spectrum Analysis

With Option 4395A-1D6, the 4395A offers time-gated spectrum analysis capability to capture and measure repetitive burst signals in video, disk drives, communication equipment, and more. The minimum gate length is 6μ sec so that even narrow-burst signals can be analyzed.

Impedance Measurement Function and RF Impedance Test Kit

A full-featured impedance measurement function (useful for quick-check general-purpose impedance applications) can be added to the 4395A by adding Option 4395A-010 and the 43961A RF impedance test kit. Covering from 100 kHz to 500 MHz, impedance parameters $|Z|$, θ , C, L, Q, D, and more, are directly measured and displayed on the TFT color display. The basic impedance measurement accuracy is 3%. A 7 mm connector is mounted on this kit for easy connection to an appropriate impedance test fixture. A wide variety of fixtures can be used with this test kit, including the surface-mount-device (SMD) fixtures. The Option 4395A-001 DC source is useful in applying DC voltage to the device up to 40 V.

4395A Specifications Summary

Network Measurement

Frequency Characteristics

- Range: 10 Hz to 500 MHz
- Resolution: 1 mHz
- Accuracy: $< \pm 5.5$ ppm (Option 4395A-1D5: $< \pm 0.13$ ppm)

Output Characteristics

- Power Range: -50 to $+15$ dBm
- Resolution: 0.1 dB
- Level Accuracy: ± 1.0 dB @ 0 dBm, 50 MHz

Receiver Characteristics

- Frequency Range: 10 Hz to 500 MHz
- Noise Level (referenced to full scale input level, $23 \pm 5^\circ\text{C}$):
 - -85 dB (typical) @ $10 \text{ Hz} \leq f < 100 \text{ Hz}$, IFBW = 2 Hz
 - -85 dB @ $100 \text{ Hz} \leq f < 100 \text{ kHz}$, IFBW = 10 Hz
 - $(-115 + f/100 \text{ MHz})$ dB @ $100 \text{ kHz} \leq f$, IFBW = 10 Hz
- IF Bandwidth (Hz): 2, 10, 30, 100, 300, 1 k, 3 k, 10 k, 30 k

Dynamic Accuracy

Input Level (relative to full scale input level –10 dB)	Dynamic Accuracy Frequency ≥100 Hz
Magnitude Dynamic Accuracy	
0 dB ≥ input level ≥ –10 dB	±0.4 dB
–10 dB > input level ≥ –60 dB	±0.05 dB
–60 dB > input level ≥ –80 dB	±0.3 dB
–80 dB > input level ≥ –100 dB	±3 dB
Phase Dynamic Accuracy	
0 dB ≥ input level ≥ –10 dB	±3°
–10 dB > input level ≥ –60 dB	±0.3°
–60 dB > input level ≥ –80 dB	±1.8°
–80 dB > input level ≥ –100 dB	±18°

@ R port input level = full scale input level –10 dB, IFBW = 10 Hz, 23 ± 5°C

Spectrum Measurement

Frequency Characteristics

- Frequency Range: 10 Hz to 500 MHz

Frequency Reference

- Accuracy: <±5.5 ppm (Option 4395A-1D5: <±0.13 ppm)

Resolution Bandwidth (RBW)

- Range: 1 Hz to 1 MHz, 1-3-10 step @ span >0
3 k, 5 k, 10 k, 20 k, 40 k, 100 k, 200 k, 400 k, 800 k, 1.5 M, 3 M,
5 MHz @ span = 0

Selectivity (60 dB/3 dB): <3 @ span >0

Noise Sidebands

- Offset
- 1 kHz –97 dBc/Hz
- 10 kHz –97 dBc/Hz
- 100 kHz –110 dBc/Hz
- 1 MHz –110 dBc/Hz

Displayed Average Noise Level

- Frequency
- 1 kHz ≤ f < 100 kHz –120 dBm/Hz
- 100 kHz ≤ f < 10 MHz –133 dBm/Hz
- 10 MHz ≤ f (–145 + f/100 MHz) dBm/Hz

Spurious Response

- Second Harmonic Distortion: –70 dBc @ –16 dB full scale
- Third-Order Intermodulation Distortion: –70 dBc @ –16 dB full scale
- Other Spurious: –70 dBc @ –16 dB full scale
- Scale Fidelity: ±0.05 dB @ 0 to –30 dB from full scale input level –10 dB

Impedance Measurement (Option 4395A-010, 43961A)

Measurement Parameters: |Z|, θz, |Y|, θy, R, X, G, B, Cp, Cs, Lp, Ls, Rp, Rs, D, Q, |Γ|, θγ, Γx, Γy

Frequency Range: 100 kHz to 500 MHz

Measurement Port: 7 mm connector on the 43961A Test Kit

Source Level at Measurement Port: –56 to +9 dBm @ 50 Ω

Calibration: OPEN/SHORT/LOAD calibration, OPEN/SHORT/LOAD compensation on test fixtures, port extension

Accuracy (Supplemental Performance Characteristics):

±3% basic accuracy @ 23 ± 5°C, after OPEN/SHORT/LOAD calibration

General Characteristics

Full Scale Input Level

Attenuator Setting (dB)	Full Scale Input Level Network	Full Scale Input Level Spectrum
0	–10 dBm	–20 dBm
10	0 dBm	–10 dBm
20	+10 dBm	0 dBm
30	+20 dBm	+10 dBm
40	+30 dBm	+20 dBm
50	+30 dBm	+30 dBm

Option 4395A-001 DC Voltage/Current Source

- Voltage Range: –40 V to +40 V
- Current Range: –20 mA to –100 mA, 20 mA to 100 mA

Operating Temperature/Humidity

- Disk Drive Non-Operating Condition: 0°C to 40°C, 15% to 95% RH
- Disk Drive Operating Condition: 10°C to 40°C, 15% to 80% RH

Storage Temperature/Humidity: –20°C to 60°C, 15% to 95% RH

Power Requirement: 100/120/220/240 V ±10%, 47 Hz to 66 Hz, 300 VA max.

Size: 235 mm H x 425 mm W x 553 mm D (9.4 in x 17 in x 22.12 in)

Weight: 21 kg (46.2 lb) (typical)

Key Literature

4395A/96B Awareness Brochure, p/n 5965-9374E

4395A Network/Spectrum/Impedance Analyzer, Technical Specifications, p/n 5965-9340E

Dramatic Speed Improvement for Narrow RBW Sweeps by

Audio/Video/IF/RF/Spectrum Analyzers, p/n 5966-4099E

Network, Spectrum, and Impedance Evaluation of Electronic Circuits

and Components, p/n 5967-5942E

How to Measure Noise Accurately Using the Combination Analyzers, p/n 5966-2292E

ADSL Copper Loop Measurements, p/n 5968-1196E

Switching Power Supply Evaluation, p/n 5968-7274E

Ordering Information

4395A Network/Spectrum/Impedance Analyzer

4395A-001 Add DC Source

4395A-010 Add Impedance Measurement Function (Requires 43961A)

4395A-1D5 Add High Stability Frequency Reference

4395A-1D6 Add Time-Gated Spectrum Analysis

4395A-1D7 50 Ω to 75 Ω Minimum Loss Pads

4395A-810 Add Keyboard

4395A-A6J ANSI Z540 compliant

87511A 50 Ω S-Parameter Test Sets

87511B 75 Ω S-Parameter Test Sets

87512A 50 Ω Transmission/Reflection Test Kits

87512B 75 Ω Transmission/Reflection Test Kits

43961A RF Impedance Test Kit (add test fixture listed below)

16192A Parallel Electrode SMD Test Fixture

16194A High Temperature Component Test Fixture

16196A/B/C/D Parallel Electrode SMD Test Fixture

16197A Bottom Electrode SMD Test Fixture

16092A Spring Clip Test Fixture

41800A Active Probe

41802A 1 MΩ Input Adapter

- Full-vector network and spectrum measurement and analysis
- Wide dynamic range network measurement with fast sweep speeds
- ± 0.05 dB/ $\pm 0.3^\circ$ dynamic magnitude/phase accuracy
- Extremely fast narrowband spectrum measurement
- Impedance analysis option and test kit available
- ± 1.0 dB level accuracy for spectrum analysis
- -150 dBm/Hz sensitivity for spectrum analysis
- Built-in IBASIC for easy test automation
- Time-gated spectrum analysis option
- Color TFT display and built-in disk drive/RAM disk



4396B with 85046A

4396B RF Network/Spectrum/Impedance Analyzer

The 4396B provides excellent RF vector network, spectrum, and optional impedance measurements for lab and production applications. When combined with a test set, the 4396B provides reflection measurements, such as return loss, and SWR, and S-parameters. Gain, phase, group delay, distortion, spurious, CN, and noise measurements often required for evaluating components and circuits can be measured using one instrument. As a vector network analyzer, the 4396B operates from 100 kHz to 1.8 GHz with 1 mHz resolution and its integrated synthesized source provides -60 to $+20$ dBm of output power with 0.1 dB resolution. The dynamic magnitude and phase accuracy are ± 0.05 dB and $\pm 0.3^\circ$ so that it can accurately measure gain and group delay flatness, which are becoming more important in modern electronics systems.

As a spectrum analyzer, the 4396B operates from 2 Hz to 1.8 GHz with resolution bandwidths (RBWs) spanning 1 Hz to 3 MHz in a 1-3-10 sequence. A fully-synthesized local oscillator allows stable and accurate frequency analysis. Direct A/D conversion (no LOG amplifier is used) results in ± 1.0 dB overall level accuracy. Noise sidebands fall below -105 dBc/Hz offset 10 kHz from carriers below 1 GHz, while sensitivity is -150 dBm/Hz at 10 MHz and -147 dBm/Hz at 1 GHz. In addition, with two independent display channels available, you can simultaneously view network and spectrum (or transmission and reflection) characteristics of the device under test in split-screen format. For example, an amplifier's frequency response (network measurement) and distortion (spectrum measurement) can be shown at the same time.

Extremely Fast Spectrum Measurement

The 4396B features a stepped Fast Fourier Transform (FFT) digital-signal-processing (DSP) technique for 20 to 100 times faster narrowband spectrum measurement than swept-tuned spectrum analyzers. The stepped FFT is performed when the resolution bandwidth (RBW) is set at 3 kHz or below. For example, with a 30 Hz RBW and 10 kHz span, the 4396B has a sweep time of 400 ms, while swept-tuned spectrum analyzers take a few tens of seconds. The stepped FFT can greatly improve the speeds of narrowband spectrum measurement such as frequency tuning of a VCO or CN measurements.

Time-Gated Spectrum Analysis

With Option 4396B-1D6, the 4396B offers time-gated spectrum analysis capability to capture and measure repetitive burst signals in video, disk drives, communication equipment, and more. The minimum gate length is 2 μ sec so that even narrow-burst signals can be analyzed.

Impedance Measurement Function and RF Impedance Test Kit

A full-featured impedance measurement function (useful for quick-check general-purpose impedance applications) can be added to the 4396B by adding Option 4396B-010 and the 43961A RF impedance test kit. Covering from 100 kHz to 1.8 GHz, impedance parameters $|Z|$, θ , C, L, Q, D, and more, are directly measured and displayed. The basic impedance accuracy (typical value) is 3%. The 43961A RF impedance test kit is designed for the 4396B and is required to utilize the features of Option 4396B-010. A 7 mm connector is mounted on this kit for easy connection to an appropriate impedance test figure. A wide variety of Agilent test fixtures can be used with the test kit, including the surface-mount-device (SMD) fixtures.

4396B Specifications Summary

Network Measurement

Frequency Characteristics

- Range: 100 kHz to 1.8 GHz
- Resolution: 1 mHz
- Accuracy: $\leq \pm 5.5$ ppm (Option 4396B-1D5: $\leq \pm 0.13$ ppm)

Output Characteristics

- Power Range: -60 to $+20$ dBm
- Resolution: 0.1 dB
- Level Accuracy: $\leq \pm 0.5$ dB

Receiver Characteristics

- Frequency Range: 100 kHz to 1.8 GHz
- Noise Level (10 Hz IFBW, ≥ 10 MHz, f = frequency in GHz):
 - $< (-125 + 3 \times f)$ dBm (A, B inputs);
 - $< (-100 + 3 \times f)$ dBm (R input)
- Full Scale Input Level: -5 dBm (A, B), $+20$ dBm (R)
- IF Bandwidth (Hz): 10, 30, 100, 300, 1 k, 3 k, 10 k, 40 k

Dynamic Accuracy

Input level (relative to full scale input level)

Magnitude Dynamic Accuracy

0 dB	<±0.3 dB
-10 to -70 dB	<±0.05 dB
-80 dB	<±0.1 dB
-90 dB	<±0.3 dB
-100 dB	<±1.0 dB
-110 dB	<±0.8 dB typical
-120 dB	<±2.5 dB typical

Phase Dynamic Accuracy

0 dB	<±3°
-10 dB	<±0.6°
-20 to -70 dB	<±0.3°
-80 dB	<±0.7°
-90 dB	<±2°
-100 dB	<±7°
-110 dB	<±8° typical
-120 dB	<±25° typical

@ 23 ±5°C, IFBW 10 Hz, R input = -35 dBm

Measurement Throughput Summary (IFBW 40 kHz, ms)

Measurement (with THRU Cal)	51	201	401	801
(1) Magnitude	62	138	239	443
(2) Magnitude and phase	84	227	417	798

Spectrum Measurement

Frequency Characteristics

- Frequency Range: 2 Hz to 1.8 GHz

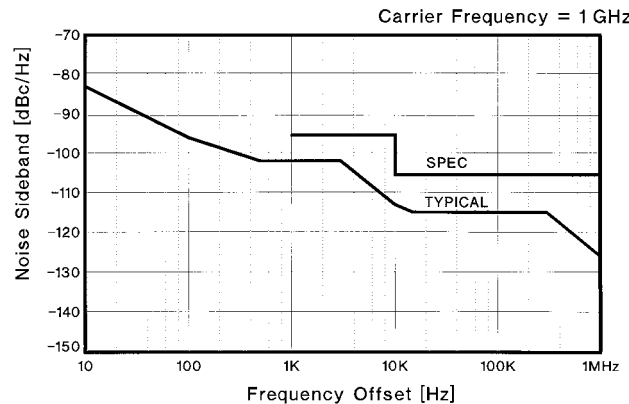
Frequency Reference

- Accuracy: <±5.5 ppm (Option 4396B-1D5: <±0.13 ppm)

Resolution Bandwidth (RBW)

- Range: 1 Hz to 3 MHz, 1-3-10 step
- Selectivity (60 dB/3 dB): RBW ≥10 kHz: <10; RBW ≤3 kHz: <3

Noise Sidebands



Noise sidebands normalized to 1 Hz RBW versus offset from carrier (typical)

Displayed Average Noise Level

(@ frequency ≥10 MHz, ref. level ≤-40 dBm, att. = 0 dBm):

<(-150 + 3f (GHz)) dBm/Hz

Spurious Response

- Second Harmonic Distortion (@ ≥10 MHz, -35 dBm mixer input): <-70 dBc
- Third-Order Intermodulation Distortion (@ ≥10 MHz, -30 dBm, separation >20 kHz): <-75 dBc

Other Spurious (@ -30 dBm mixer input, offset ≥1 kHz): <-70 dBc

Scale Fidelity: ±0.05 dB @ 0 to -30 dB from ref. level

Impedance Measurement (Option 4396B-010, 43961A)

Measurement Parameters: |Z|, θz, |Y|, θy, R, X, G, B, Cp, Cs,

Lp, Ls, Rp, Rs, D, Q, |Γ|, θγ, Γx, Γy

Frequency Range: 100 kHz to 1.8 GHz

Measurement Port: 7 mm connector on the 43961A Test Kit

Source Level at RF out: -60 to +20 dBm (6 dB lower at 43961A port)

DC Bias: ±40 V (20 mA maximum). A 2 kΩ ±5% internal resistor is used for dc bias current limitation. An external dc bias source is required.

Connector: BNC (f) on 43961A.

Calibration: OPEN (0 S)/SHORT (0 Ω)/LOAD (50 Ω) calibration, OPEN/SHORT/LOAD compensation on test fixtures, port extension compensation

Accuracy (Supplemental Performance Characteristics): 3% basic accuracy at 23°C ±5°C, after OPEN/SHORT/LOAD calibration

General Characteristics

Operating Temperature/Humidity: 0°C to 40°C, 15% < RH <95%

Storage Temperature: -20°C to 60°C

Power Requirement: 90 V to 132 V, 198 V to 264 V, 47 Hz to 63 Hz, 300 VA max.

Weight: 21.5 kg (47.3 lb) typical

Size: 235 mm H x 425 mm W x 553 mm D (9.4 in x 17 in x 22.12 in)

Key Literature

4395A/96B Awareness Brochure, p/n 5965-9374E

4396B 1.8 GHz Network/Spectrum Analyzer Technical Data,

p/n 5965-6311E

Combining Network and Spectrum Analyzers and IBASIC to improve

device characterization and test time, p/n 5965-7656E

Configuring the 4396B for O/E Testing, p/n 5965-7657E

How to Characterize CATV Amplifiers Effectively, p/n 5965-9434E

Dramatic Speed Improvement for Narrow RBW Sweeps by

Audio/Video/IF/RF/Spectrum Analyzers, p/n 5966-4099E

Network, Spectrum, and Impedance Evaluation of Electronic Circuits

and Components, p/n 5967-5942E

How to Measure Noise Accurately Using the Combination Analyzers,

p/n 5966-2292E

Ordering Information

4396B Network/Spectrum/Impedance Analyzer

4396B-010 Add Impedance Measurement Function (Requires 43961A)

4396B-1D5 Add High Stability Frequency Reference

4396B-1D6 Add Time-Gated Spectrum Analysis

4396B-1D7 50 ohm to 75 ohm Minimum Loss Pads

4396B-810 Add Keyboard

4396B-A6J ANSI Z540 Compliant

85046A 50 Ω S-Parameter Test Sets

85046B 75 Ω S-Parameter Test Sets

87512A 50 Ω Transmission/Reflection Test Kits

87512B 75 Ω Transmission/Reflection Test Kits

43961A RF Impedance Test Kit (add test fixtures listed below)

16192A Parallel Electrode SMD Fixture (dc to 2 GHz)

16194A High Temperature Component Test Fixture

16196A/B/C/D Parallel Electrode SMD Test Fixture

16197A Bottom Electrode SMD Test Fixture

16092A Spring-Clip Fixture (dc to 500 MHz)

41800A Active Probe

41802A 1 MΩ Input Adapter

43961A
87511A
87511B
87512A
87512B
41800A



43961A

43961A RF Impedance Test Kit

The 43961A RF impedance test kit provides the capability to measure impedance parameters of 1-port devices with the 4395A with Option 4395A-010 (100 kHz to 500 MHz) or the 4396B with Option 4396B-010 (100 kHz to 1.8 GHz). The test port of the 43961A is a 7 mm connector and can be used with the 16196A/B/C/D, 16197A, or 7 mm type test fixtures. The 43961A includes open/short/load calibration standards, and the test fixtures such as 16197A are optional.

Frequency Range: 100 kHz to 1.8 GHz (100 kHz to 500 MHz with 4395A)
Measurement Parameters: $|Z|$, $|Y|$, θ , R, X, G, B, Cp, Cs, Lp, Ls, Rp, Rs, D, Q, $|\Gamma|$



87511A

87511A/B S-parameter Test Sets

The 87511A/B S-parameter test sets provide the capability to measure S-parameters of 2-port devices from 100 kHz to 500 MHz with a network analyzer. The test ports of the 87511A are 50 Ω connectors (Option 87511A-008: 7 mm or Option 87511A-001: type N(f)), and the test ports of the 87511B are 75 Ω type N(f) connectors. Calibration kits are not included.

Frequency Range: 100 kHz to 500 MHz
Test Port Impedance: 87511A, 50 Ω ; 87511B, 75 Ω

	87511A	87511B
Directivity		
100 kHz to 300 kHz	30 dB	30 dB
300 kHz to 200 MHz	40 dB	33 dB
200 MHz to 500 MHz	35 dB	33 dB
Nominal Insertion Loss		
RF IN to port 1, 2	13 dB	19 dB
RF IN to R, A, B	19 dB	31 dB

Size: 90 mm H x 432 mm W x 495 mm D (3.6 in x 17.28 in x 19.8 in)
Weight: 5.7 kg (12.54 lb) (typical)



87512A

87512A/B Transmission/Reflection Test Kits

87512A/B transmission/reflection test kits provide the capability to measure the reflection and transmission characteristics of 50 Ω or 75 Ω devices up to 2 GHz with an Agilent network analyzer. The test port of the 87512A is a 50 Ω type N(f) connector, and the test port of the 87512B is a 75 Ω type N(f) connector. The 87512A/B include precision short/load termination for calibration.

Frequency Range: DC to 2 GHz
Test Port Impedance: 87512A, 50 Ω ; 87512B, 75 Ω
Equivalent Directivity: 40 dB (typical)
Insertion Loss: 10 dB \pm 1 dB



41800A

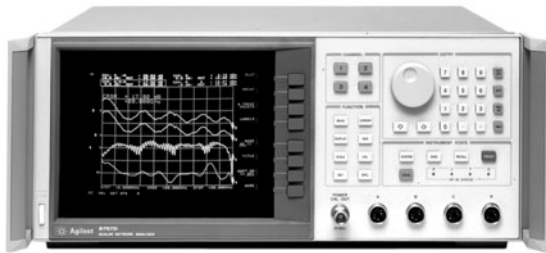
41800A Active Probe

The 41800A active probe provides high input impedance from 5 Hz to 500 MHz. The 41800A is a valuable tool when used with a network and spectrum analyzer for circuit signal analysis.

Specifications

Bandwidth: 5 Hz to 500 MHz
Output Connector: 50 Ω type N male
Input R,C (typical): 100 k Ω , 3 pF (probe alone); 1 M Ω , 1 pF (with 10:1, 100:1 divider)
Frequency Response relative to 50 MHz: \pm 1 dB @ 50 Hz to 200 MHz
Average Noise Level: 10 nV/ $\sqrt{\text{Hz}}$ @ \geq 300 kHz
Second Harmonic Distortion: $<$ -50 dBc @ 20 dBm (250 MHz) input (typical)
Third-Order Intermodulation Distortion: $<$ -70 dBc @ -26 dBm two signal input (typical)
1 dB Gain Compression: $>$ +3 dBm input @ 500 MHz

- 75 dB dynamic range
- Optional power calibrator
- 40 dB directivity bridges
- Buffered plotter/printer output
- External disk and internal register save/recall
- Built-in limit testing
- Color display



8757D-001 & -002

8757D Scalar Network Analyzers

Measure insertion loss, gain, return loss, SWR, and power quickly and accurately with the 8757D scalar network analyzer. With high-performance detectors and directional bridges, and a companion source and digital plotter, the 8757D is the basis of a complete measurement system with superb performance.

The 8757D features three detector inputs and two independent display channels, allowing simultaneous ratioed or non-ratioed measurement of your device's transmission and reflection characteristics, 75 dB dynamic range (+20 to -55 dBm) for measuring high-rejection devices, and a choice between ac (square wave modulated) or dc detection techniques. The internal plotter/printer buffer allows you to send your measurement data directly to a plotter and then proceed to the next measurement, typically in less than five seconds. The 8757D includes a user-friendly interface, and menu-driven, direct-access softkeys, which simplify its operation.

It offers limit testing, external disk save/recall, and a color display. Limit testing reduces test time by letting the analyzer make quick and objective pass/fail decisions. External disk save/recall allows your measurement state to be preconfigured by an engineer or skilled specialist and then automatically recalled by production technicians. The result is reduced set-up time and greater test integrity at each production station. The precision color display simplifies the separation of measurement information while providing a pleasant display for the technician.

Increase Absolute Power Measurement Accuracy

For near power meter measurement accuracy, configure a system that includes the 8757D Option 002 and the 85037 series precision detectors. Option 002 on the 8757D adds an internal power calibrator used to characterize the 85037 series detectors' accuracy versus power. In addition, each 85037 series precision detector incorporates a dual-diode detector to improve power measurement accuracy when harmonics are present, plus internal frequency correction factors, read by the 8757D, for more accurate power versus frequency measurements. The result is a system optimized for swept absolute power measurements.

Feature	8757D
Display	Color
Display channels	4
Detector inputs	3 standard 4 with Option 001
Dynamic range	75 dB
AC/DC detection mode	Yes
Measurement points:	
Selectable values	101, 201, 401, 801, 1601
Channels displayed	3 or 4 2 1
Max. points per channel	401 801 1601
Plotter/printer buffer	Yes
Noise figure display capability*	Yes
External disk save/recall	Yes
Internal save/recall registers	9
Limit testing (channels 1 and 2)	Yes
Adaptive normalization	Yes
Cursor search functions	Max., Min., bandwidth, n dB
SWR display mode	Yes
Non-standard sweep mode	Yes
Auxiliary voltage display mode	Yes
Optional power calibrator	Yes
Compatible with 85037 series precision detectors	Yes

*Product Note 8970 B/S-4, Agilent Literature 5959-8742

Size: 178 mm H x 425 mm W x 445 mm D (7 in x 16.75 in x 17.5 in)

Weight: 22 kg (48 lb) net; 28 kg (61.5 lb) shipping

Transit Cases

Agilent offers a complete line of sturdy transit cases in Valise and Tote styles. The cases protect your instrument from shock, vibration, moisture, impact, and contamination, providing a secure enclosure for shipping. Model 9211-2650 (standard) or model 9211-7521 (tote) fit the 8757D/E.

85037 Series Precision Detectors (ac/dc)

The 85037 series precision detectors are designed specifically for operation with the 8757D scalar network analyzer and may be used in either ac or dc detection modes. These dual diode detectors contain internal frequency correction factors in an internal EE PROM (read automatically by the 8757D) for improved measurement accuracy versus frequency. When used in conjunction with the 8757D's internal power calibrator (Option 002), these detectors provide the maximum absolute power measurement accuracy. The 85037 series detector is not compatible with the 8757E.

Absolute Power Measurement Uncertainty Examples

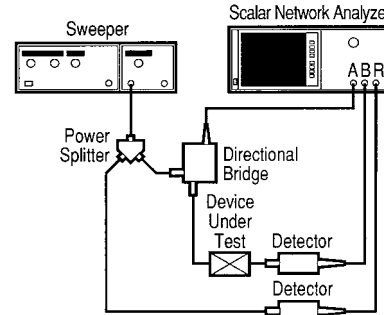
Assumptions:

- Measurement frequency = 10 GHz
- DUT input/output SWR = 1.5
- Measured power = 0 dBm

Uncertainty Component	85037B Detector	85025E Detector
Absolute power accuracy at 50 MHz (±dB)	0.11	0.40
Frequency response (±dB)	0.18	0.50
Mismatch (±dB)	0.18	0.10
Uncertainty Total (±dB)	0.47	1.00

Reflection Measurement Accuracy

Uncertainties due to calibration error and the frequency response of the source, detectors, and bridges are removed via open/short averaging. The remaining uncertainties are primarily the sum of directivity uncertainty, effective source match uncertainty and dynamic power accuracy. See Technical Data Sheet for further information.



Basic scalar coaxial system configured for ratio reflection and transmission measurements.

Precision Detector Summary, 85037 Series For use with the 8757D in either ac or dc detection modes

Model	Frequency Range	Connector Type	Dynamic Range	Frequency	Return Loss	Frequency Response	Power (at 50 MHz)	Dynamic Accuracy ¹	Absolute Accuracy ²
85037A ¹	10 MHz to 18 GHz	Type-N (m) 7 mm ²	ac mode +20 to -55 dBm dc mode +20 to -50 dBm	0.01 to 0.04 GHz 0.04 to 18.0 GHz	10 dB 20 dB	±0.35 dB ±0.18 dB	20 dBm 10 dBm -30 dBm -50 dBm	±0.25 dB ±0.11 dB ±0.11 dB ±0.85 dB	±0.25 dB ±0.11 dB ±0.11 dB ±0.85 dB
85037B ¹	10 MHz to 26.5 GHz	3.5 mm (m)	ac mode +20 to -55 dBm dc mode +20 to -50 dBm	0.01 to 0.04 GHz 0.04 to 18.0 GHz 18 to 26.5 GHz	10 dB 20 dB 18 dB	±0.35 dB ±0.18 dB ±0.22 dB	20 dBm 10 dBm -30 dBm -50 dBm	±0.25 dB ±0.11 dB ±0.11 dB ±0.85 dB	±0.25 dB ±0.11 dB ±0.11 dB ±0.85 dB

85025 and 85026 Series Detectors (ac/dc)

The 85025 and 85026 series detectors are designed specifically for operation with the 8757 scalar network analyzer. The 85025/26 detectors detect either a modulated (ac) or an unmodulated (dc) microwave signal.

85025C Detector Adapters

The 85025C adapter matches the scalar analyzer display to most standard crystal, silicon and gallium arsenide detectors. This enables the user to operate up to 110 GHz with the 8757. The 85025C detector adapter is designed for use with the 8757 only, and can operate in either ac or dc detection modes.

Coaxial Detector Summary, 85025 Series For use with the 8757 only in either ac or dc detection modes

Model	Frequency Range	Connector Type	Dynamic Range	Frequency	Return Loss	Frequency Response	Power (at 50 MHz)	Dynamic Accuracy ¹	Absolute Accuracy ⁵
85025A ¹	10 MHz to 18 GHz	Type-N (m) 7 mm ²	ac mode +16 to -55 dBm dc mode +16 to -50 dBm	0.01 to 0.04 GHz 0.04 to 4 GHz 4 to 18 GHz	10 dB 20 dB 17 dB	±0.8 dB ±0.5 dB ±0.5 dB	16 dBm 6 dBm -35 dBm -50 dBm	±0.8 dB ±0.4 dB ±0.4 dB ±1.3 dB	±0.8 dB ±0.4 dB ±0.4 dB ±1.3 dB
85025B ¹	10 MHz to 26.5 GHz	3.5 mm (m)	ac mode +16 to -55 dBm dc mode +16 to -50 dBm	0.01 to 0.04 GHz 0.04 to 4 GHz 4 to 18 GHz 18 to 26.5 GHz	10 dB 20 dB 17 dB 12 dB	±0.8 dB ±0.5 dB ±0.5 dB ±2.0 dB	16 dBm 6 dBm -35 dBm -50 dBm	±0.8 dB ±0.4 dB ±0.4 dB ±1.3 dB	±0.8 dB ±0.4 dB ±0.4 dB ±1.3 dB
85025D ¹	10 MHz to 50 GHz	2.4 mm (m)	ac mode +16 to -55 dBm dc mode +16 to -50 dBm	0.01 to 0.1 GHz 0.1 to 20 GHz 20 to 26.5 GHz 26.5 to 40 GHz 40 to 50 GHz	10 dB 20 dB 20 dB 15 dB 9 dB	±0.8 dB ±0.5 dB ±1.0 dB ±2.5 dB ±3.0 dB	16 dBm 6 dBm -35 dBm -50 dBm	±1.0 dB ±0.4 dB ±0.4 dB ±1.3 dB	±1.0 dB ±0.4 dB ±0.4 dB ±1.3 dB
85025E ¹	10 MHz to 26.5 GHz	3.5 mm (m)	ac mode +16 to -55 dBm dc mode +16 to -50 dBm	0.01 to 0.1 GHz 0.1 to 18 GHz 18 to 25 GHz 25 to 26.5 GHz	10 dB 25 dB 25 dB 23 dB	±0.8 dB ±0.5 dB ±0.5 dB ±1.4 dB	16 dBm 6 dBm -35 dBm -50 dBm	±1.0 dB ±0.4 dB ±0.4 dB ±1.3 dB	±1.0 dB ±0.4 dB ±0.4 dB ±1.3 dB

¹ The 85037A/B specifications are applicable when used with the 8757D scalar network analyzer. The absolute power accuracy and dynamic power accuracy specifications apply after a calibration via the 8757D Option 002's internal power calibrator.

² Option 001 changes to a 7-mm connector.

³ The 85025 and 85026 series detectors and the 85025C detector adapter require 8757A firmware revision 2.0 or higher. To upgrade previous revisions, order the 11614A firmware enhancement.

⁴ Dynamic accuracy refers to measurement accuracy as power varies (in dB) from a 0 dBm reference, 25° ± 5°C, 50 MHz.

⁵ DC mode, 25° ± 5°C.

Waveguide Detectors and Detector Adapters Summary For use with the Agilent 8757 only in either ac or dc detection modes

Model	Frequency Range	Connector Type	Dynamic Range	Return Loss	Frequency Response	Dynamic Accuracy
R85026A¹	26.5 to 40 GHz	WR-28	+10 to -50 dBm (ac mode) +10 to -45 dBm (dc mode)	12 dB	±1.5 dB	±(0.3 dB + 0.03 dB/dB)
Q85026A¹	33 to 50 GHz	WR-22	+10 to -50 dBm (ac mode) +10 to -45 dBm (dc mode)	12 dB	±2.0 dB	±(0.3 dB + 0.03 dB/dB)
U85026A	40 to 60 GHz	WR-19	+10 to -50 dBm (ac mode) +10 to -45 dBm (dc mode)	12 dB	±2.0 dB	±(0.3 dB + 0.03 dB/dB)
85025C Option K57³	50 to 75 GHz	WR-15	+10 to -45 dBm (typical)	9.5 dB (typical)	—	—
85025C Option K71³	75 to 110 GHz	WR-10	+10 to -45 dBm (typical)	9.5 dB (typical)	—	—
85025C¹	²	SMA (m)	²	²	²	²

¹ The 85025 and 85026 series detectors and the 85025C detector adapter require 8757A firmware revision 2.0 or higher. To upgrade previous revisions, order the 11614A firmware enhancement.

² Depends upon the particular detector being used.

³ Must be used with the 85025C detector adapter.

85027 Series Directional Bridges (ac/dc)

The 85027 series directional bridges are designed to operate with either the 8757 in ac or dc detection modes. These bridges offer high directivity, excellent test port match, and a measurement range of up to 50 GHz in coax.

8757D Option 002 Power Calibrator

The 8757D's internal power calibrator provides a 50 MHz reference standard for characterizing the absolute power accuracy and dynamic power accuracy of the 85037 series precision detectors.

Frequency: 50 MHz ± 0.2 MHz

Accuracy at 0 dBm: ±0.05 dB

Linearity: (over any 10 dB range)

±0.08 dB (+20 to +10 dBm)

±0.04 (+10 to -30 dBm)

±0.06 (-30 to -50 dBm)

Directional Bridge Summary For use with the Agilent 8757 in ac or dc detection mode

Model	Frequency Range	Nominal Impedance	Connector – Input	Connector – Test Port	Frequency	Directivity (dB)	Frequency	Test Port Match (SWR)
85027A	10 MHz to 18 GHz	50 Ω	Type-N (f)	7 mm	0.01 to 18 GHz	40 dB	0.01 to 8.4 GHz 8.4 to 12.4 GHz 12.4 to 18 GHz	<1.15 <1.25 <1.43
85027B	10 MHz to 26.5 GHz	50 Ω	3.5 mm (f)	3.5 mm (f)	0.01 to 20 GHz 20 to 26.5 GHz	40 dB 36 dB	0.01 to 8.4 GHz 8.4 to 20 GHz 20 to 26.5 GHz	<1.15 <1.43 <1.78
85027C	10 MHz to 18 GHz	50 Ω	Type-N (f)	Type-N (f)	0.01 to 12.4 GHz 12.4 to 18 GHz	36 dB 34 dB	0.01 to 8.4 GHz 8.4 to 12.4 GHz 12.4 to 18 GHz	<1.15 <1.25 <1.43
85027D	10 MHz to 50 GHz	50 Ω	2.4 mm (f)	2.4 mm (m)	0.01 to 20 GHz 20 to 26.5 GHz 26.5 to 40 GHz 40 to 50 GHz	36 dB 32 dB 30 dB 25 dB	0.01 to 16 GHz 16 to 30 GHz 30 to 40 GHz 40 to 50 GHz	<1.18 <1.27 <1.57 typically <2.00
85027E	10 MHz to 26.5 GHz	50 Ω	3.5 mm (f)	3.5 mm (m)	0.01 to 20 GHz 20 to 26.5 GHz	40 dB 36 dB	0.01 to 8.4 GHz 8.4 to 20 GHz 20 to 26.5 GHz	<1.15 <1.43 <1.78

System Accuracy**Transmission Loss or Gain Measurement Accuracy**

Transmission loss or gain measurements are made relative to a 0 dB reference point established at calibration. Transmission measurement uncertainty = dynamic power accuracy + mismatch uncertainty.

Dynamic power accuracy is the measurement uncertainty due to the change in power level between calibration and the measurement. Mismatch uncertainty is the uncertainty due to reflections in the measurement setup. The frequency response errors of the source, detectors, bridge and power splitter are removed via calibration.

Transmission Measurement Uncertainty Examples

Assumptions:

- Measurement frequency = 10 GHz
- DUT input/output SWR = 1.5
- Change in power after calibration <30 dB (+0 to -30 dBm range)

Uncertainty Component	85037B Precision Detector	85025E Detector
Dynamic accuracy (±dB)	0.11	0.40
Mismatch (±dB)	0.45	0.33
Uncertainty Total (±dB)	0.56	0.73



11679A



85022A



11667A



11667C

11679A/B Extension Cables

Function

These cables extend the distance between the scalar network analyzer and the detector or bridge to a maximum of 200 feet without degradation of performance.

11679A: 7.6 m (25 ft) extension cable

11679B: 61 m (200 ft) extension cable

85022A System Cable Kit

The 85022A contains all the BNC and GPIB cables to connect an Agilent sweep oscillator (8360 series, 83750, or 83751 synthesized sweepers), an HP computer and a printer to the 8757. This kit contains three one-meter GPIB cables (10833A), three two-foot BNC (m-m) cables (11170B) and one four-foot BNC (m-m) cable (11170C).

BNC Impedance: 50 Ω

Weight: Net, 0.5 kg (1.2 lb); shipping, 1.2 kg (2.9 lb)

11636A/B Power Dividers

The 11636A/B power dividers/combiners are recommended when making wideband comparison measurements without ratioing.

11613B Calibrator

The 11613B is a dedicated transfer standard for calibration of the 8757D/E scalar network analyzers. The 11613B provides a standard, a 27.778 kHz source and a series of precision attenuators. The calibrator includes software that verifies (and adjusts if necessary) the internal calibration parameters stored in the nonvolatile memory of the analyzer.

An HP Series 200 or 300 computer is required for operation. The computer must have BASIC 2.0 or greater and 512 K bytes of RAM. For use with the 8756A Scalar Analyzer, the computer also requires the HP 98622A 16-bit GPIO card.

11852B 50 Ω /75 Ω Minimum-Loss Pad

The 11852B is a low SWR minimum-loss pad required between 75 Ω devices and 50 Ω sources and detectors.

11667A/B/C Power Splitters

The 11667A/B/C power splitters are recommended when making wideband ratio measurements using the 8757 scalar network analyzer. These two-resistor type splitters provide excellent output SWR at the auxiliary arm when used for source leveling or ratio measurement applications. The tracking between output arms over a frequency range from dc to 50 GHz allows wideband measurements to be made with a minimum of uncertainty.

Frequency Range

11667A: DC to 18 GHz

11667B: DC to 26.5 GHz

11667C: DC to 50 GHz

Impedance: 50 Ω nominal

Insertion Loss

11667A/B: 6 dB nominal

11667C: 8.5 dB nominal

Max. Input Power: +27 dBm

Connectors

11667A: N-female on all ports

11667B: 3.5-mm female on all ports

11667C: 2.4-mm female on all ports

8757D Upgrade Kits

Increase your analyzer's measurement capability and performance with an 8757 upgrade kit.

The 86383C upgrade kit allows you to add the fourth detector input to your 8757D (86383C-001) and/or the internal power calibrator (86383C-002). Installation is not included with this kit.

Key Literature

8757D Scalar Network Analyzer Technical Data, p/n 5091-2471E

8757D Scalar Network Analyzer Configuration Guide, p/n 5967-6177E

The 8757 scalar network analyzer is ordered with multiple line items to give you maximum flexibility in specifying a system that meets your needs. Consult your local Agilent Technologies sales office if you would like assistance.

Ordering Information

Analyzer

- 8757D** Scalar Network Analyzer
 - 8757D-001** Fourth Detector Input
 - 8757D-002** Internal Power Calibrator
 - 8757D-W30** Two-Year Extended Service
 - 8757D-1BN** MIL-STD-45662A Calibration Certificate
 - 8757D-1BP** MIL-STD-45662A Calibration with Test Data
 - 8757D-UK6** Commercial Calibration Certificate w/data

Sweepers

Choose the PSG synthesized signal generators for applications from 10 MHz to 110 GHz

Precision Detectors

- 85037A** 0.01 to 18 GHz, Type-N(m)
- 85037A-001** 7-mm Connector
- 85037B** 0.01 to 26.5 GHz, 3.5 mm(m)

Directional Bridges

- 85027A** 0.01 to 18 GHz, 7 mm, 50 Ω
- 85027B** 0.01 to 26.5 GHz, 3.5 mm (f), 50 Ω
- 85027C** 0.01 to 18 GHz, Type-N (f), 50 Ω
- 85027D** 0.01 to 50 GHz, 2.4 mm (m), 50 Ω
- 85027E** 0.01 to 26.5 GHz, 3.5 mm (m), 50 Ω

Detectors

- 85025A** 0.01 to 18 GHz, Type-N (m)
 - 85025A-001** 7-mm Connector
- 85025B** 0.01 to 26.5 GHz, 3.5 mm (m)
- 85025D** 0.01 to 50 GHz, 2.4 mm (m)
- 85025E** 0.01 to 26.5 GHz, 3.5 mm (m)
- R85026A** 26.5 to 40 GHz, WR-28 Waveguide
- Q85026A** 33 to 50 GHz, WR-22 Waveguide
- U85026A** 40 to 60 GHz, WR-19 Waveguide
- 85025C** Detector Adapter

System Cable Kit

- 85022A** System Cable Kit

Optional Accessories

(For ratio and/or modulation measurements)

- 11636A** Power Divider dc to 18 GHz
- 11636B** Power Divider dc to 26.5 GHz
- 11667A** Power Splitter dc to 18 GHz
 - 11667A-001** N-male on Input Port; N-female on Output Ports
 - 11667A-002** N-female on Input Port; 7 mm on Output Ports
- 11667B** Power Splitter dc to 26.5 GHz
- 11667C** Power Splitter dc to 50 GHz
- 11679A** Detector Extension Cable, 7.6 m (25 ft)
- 11679B** Detector Extension Cable, 61 m (200 ft)
- 11852B** 50 to 75 Ω Minimum Loss Pad

Upgrade Kits

- 86383C** Upgrade Kit for 8757D
 - 86383C-001** Adds Fourth Detector Input
 - 86383C-002** Adds Internal Power Calibrator

Transit Cases

- 9211-2650** Standard Transit Case
- 9211-7521** Tote-Style Transit Case

For information on compatible printers, visit our web site:
www.agilent.com/find/pcg

8757D

- Full crossbar matrix available at 4-, 6-, 8-, 12-, and 16-ports
- Internal couplers enable the highest accuracy for your multiport systems
- Option 550 adds 4-port calibration to 2-port PNA/PNA-L/PNA-X
- Option 551 adds full-port calibration to 2- or 4-port PNA/PNA-L/PNA-X
- Control your DUT during testing with test set control lines



4-port PNA-L network analyzer with Z5623AK44 multiport test set

Agilent Multiport Test Sets Extend Network Analysis Capabilities to a Greater Number of Test Ports, Increase Throughput, and Enable the Best Accuracy for your Multiport Applications

Many of today's wireless communications and broadband components have three, four or even more ports. These components require multiple connections for complete characterization with a two-port network analyzer. However, time-to-market pressures require these multiport components to be tested quickly while maintaining high levels of accuracy and high repeatability to achieve the desired production volumes. Multiport test sets used in conjunction with standard network analyzers dramatically reduce overall tune and test times because the DUT only needs to be connected once to test multiple signal paths. Minimizing the number of connections also reduces operator fatigue, and lowers the chance of connection to the wrong port. In addition, fewer connections mean less wear on cables, connectors, fixtures and DUTs. A multiport test set is especially valuable in manufacturing applications where the time required for device connection, handling, and/or configuration is significantly greater than the test time.

Agilent provides high-performance multiport test solutions to meet the demands of the never-ending trend to decrease size through integration of modules, and the pressure to increase throughput and lower test cost. A variety of solutions are available for testing devices ranging from integrated front-end modules to base station combiner/divider units to satellite manifolds. These solutions combine hardware, firmware, and sometimes software, plus electronic calibration, to provide high accuracy and fast measurement speeds. For more information, contact your local Agilent Field Engineer or visit www.agilent.com/find/multiport

Key Literature

Test Solutions for Multiport and Balanced Devices Selection Guide, p/n 5988-2461EN

Test Set	Number of Ports ¹	Frequency Range	Recommended Network Analyzer	Features
N4420B	4	10 MHz to 40 GHz	PNA E8363B opt 014/550 N1930B PLTS signal integrity software	– Solid-state switches for fast and repeatable measurements – N1930B adds eye diagrams, RLCG model extraction and advanced data display
N4421B	4	10 MHz to 50 GHz	PNA E8364B opt 014/550 N1930B PLTS signal integrity software	– Solid-state switches for fast and repeatable measurements – N1930B adds eye diagrams, RLCG model extraction and advanced data display
N4421BH67	4	10 MHz to 67 GHz	PNA E8361A opt 014/550 N1930B PLTS signal integrity software	– Solid-state switches for fast and repeatable measurements – N1930B adds eye diagrams, RLCG model extraction and advanced data display
Z5623AK64	4, 6	10 MHz to 20 GHz	PNA E8362B opt 014/550 PNA-L N5230A opt 225/550, opt 245/551 PNA-X N5242A opt 200/550, 400/551	– Solid-state switches for fast and repeatable measurements – High power capability on test set ports, up to +38 dBm
Z5623AK44	8	10 MHz to 20 GHz	PNA-L N5230A opt 245/551 PNA-X N5242A opt 400/551	– Solid-state switches for fast and repeatable measurements – AUX inputs to add signal conditioning or connect to external instruments
Z5623AK66	14	10 MHz to 20 GHz	PNA-L N5230A opt 245/551	– Dual 9-port full crossbar with solid-state switches – Front-end mechanical switches expand number of test ports with minimum insertion loss
U3042AE08	12	10 MHz to 20 GHz	PNA-L N5230A opt 245/551 PNA-X N5242A opt 400/551 N1930B PLTS signal integrity software	– Solid-state switches for fast and repeatable measurements – N1930B adds eye diagrams, RLCG model extraction and advanced data display
U3022AE10	12	10 MHz to 20 GHz	PNA E8362B opt 014/551 PNA-L N5230A opt 225/551 N1930B PLTS signal integrity software	– Mechanical switches for high accuracy and stability – N1930B adds eye diagrams, RLCG model extraction and advanced data display
U3025AE10	12	10 MHz to 50 GHz	PNA E8364B opt 014/551 PNA-L N5230A opt 525/551 N1930B PLTS signal integrity software	– Mechanical switches for high accuracy and stability – N1930B adds eye diagrams, RLCG model extraction and advanced data display
U3042AE12	16	10 MHz to 20 GHz	PNA-L N5230A opt 245/551 PNA-X N5242A opt 400/551 N1930B PLTS signal integrity software	– Solid-state switches for fast and repeatable measurements – N1930B adds eye diagrams, RLCG model extraction and advanced data display

¹ Includes analyzer and test set ports.

Calibration Kits

Error-correction procedures require that the systematic errors in the measurement system be characterized by measuring known devices (standards) on the system over the frequency range of interest. Agilent Technologies offers two types of calibration kits: mechanical and electronic. For further information about these products, please refer to the following web site www.agilent.com/find/accessories or www.agilent.com/find/nacal



Mechanical Calibration Kits

All network analyzer, coaxial mechanical calibration kits contain standards to characterize systematic errors. Many mechanical calibration kits also contain adapters for test ports and a torque wrench for proper connection. Mechanical calibration kits are divided into three categories: economy, standard, and precision. Economy kits include a fixed load. Standard kits include a sliding load or a series of offset shorts. Precision kits contain TRL devices.



Electronic Calibration (ECal) Modules

Electronic calibration (ECal) is a precision, single-connection, 1-, 2-, or 4-port calibration technique that uses fully traceable and verifiable electronic calibration modules. ECal provides repeatable, accurate measurements while bringing convenience and simplicity to your daily calibration routine. ECal replaces the traditional calibration technique that uses mechanical standards. With mechanical standards, you are required to make numerous connections to the test ports for a single calibration. These traditional calibrations require intensive operator interaction, which is prone to errors. ECal modules consist of a connector-specific calibration standard. Modules are available with 3.5 mm, 7 mm, Type-N, Type-F, 2.92 mm, 2.4 mm, 1.85 mm and 7-16 connectors. Options exist for 2-port modules with one male and one female connector (MOF), two male (00M) or two female (00F) connectors. Four-port ECal modules support both mixed-sex and mixed-connector-type configurations. In addition to the standard factory characterizations of these connector configurations, users can characterize their ECal modules with adapters on the test ports. The resulting user-characterization data can then be saved into user memories within the ECal modules. The adapters can serve as "connector savers" or be used to change connector type or connector sex, giving maximum calibration flexibility. The user-characterization feature can also bring the convenience of ECal to fixture and wafer-probe environments.

The PNA and ENA Series of network analyzers can control ECal modules directly using a USB connection. 8753 and 8720 network analyzers control ECal modules via the 85097B VNA interface kit. For more information, refer to the ECal Product Overview (literature number 5963-3743E).

PC Interface Module with Control Software

The 85097B consists of a VNA interface module, and power supply. The interface module is the interface between the parallel port on your 8753 or 8720 network analyzer, the ECal module, and the external power supply. The 85097B interfaces with the 8753E/ET/ES, the 8719D/ET/ES, the 8720D/ET/ES and the 8722D/ET/ES network analyzers.

Mechanical Verification Kits

Measuring known devices, other than the calibration standards, is a way of verifying that the network analyzer system is operating properly. Agilent offers verification kits that include precision airlines, mismatch airlines, and precision fixed attenuators. Traceable measurement data, on disk, is shipped with each kit. Verification kits may be recertified by Agilent Technologies. This recertification includes a new measurement of all standards and new data with uncertainties.

Calibration
Kits
Verification
Kits

Coaxial Mechanical Calibration Kits

Legend: O = open S = short L = load SL = sliding load TRL = TRL adapter

Device Connector Type	Frequency Upper Limit ¹	Included	Available Options	Model
Type-F (75 ohm)	3 GHz	O, S, L (m) and (f), adapters	00M, 00F	85039B
Type-N (75 ohm)	3 GHz	O, S, L (m)		85036E
Type-N (75 ohm)	3 GHz	O, S, L (m) and (f), adapters		85036B
Type-N (50 ohm)	6 GHz	O, S, L (m)		85032E
Type-N (50 ohm)	9 GHz	O, S, L (m) and (f)	100, 200, 300, 500	85032F
Type-N (50 ohm)	18 GHz	O, S, L, SL (m) and (f), adapters		85054B
Type-N (50 ohm)	18 GHz	O, S, L (m) and (f), adapters		85054D
7-16	7.5 GHz	O, S, L (m) and (f), adapters		85038A
7 mm	6 GHz	O, S, L		85031B
7 mm	18 GHz	O, S, L		85050D
7 mm	18 GHz	O, S, L, SL		85050B
7 mm	18 GHz	O, S, L, TRL		85050C
3.5 mm	9 GHz	O, S, L (m) and (f)	100, 200, 300, 400, 500	85033E
3.5 mm	26.5 GHz	O, S, L (m) and (f), adapters		85052D
3.5 mm	26.5 GHz	O, S, L, SL (m) and (f), adapters		85052B
3.5 mm	26.5 GHz	O, S, L (m) and (f), TRL adapters		85052C
2.92 mm	50 GHz	O, S, L, SL (m) and (f), adapters	001*	85056K
2.4 mm	50 GHz	O, S, L (m) and (f), adapters	001*	85056D
2.4 mm	50 GHz	O, S, L, SL (m) and (f), adapters	001*	85056A
1.85 mm	67 GHz	Offset, S, L (m) and (f), adapters		85058B
1.85 mm	67 GHz	O, S, L (m) and (f), adapters		85058E
1 mm	110 GHz	O, S, L (m) and (f), adapters		85059A

¹ All coaxial calibration kits are specified from DC to their upper frequency limit.

Waveguide Mechanical Calibration Kits

Device Connector Type	Frequency Range (GHz)	Type	Model
WR-90	8.2 to 12.4	Precision	X11644A
WR-62	12.4 to 18	Precision	P11644A
WR-42	18 to 26.5	Precision	K11644A
WR-28	26.5 to 40	Precision	R11644A
WR-22	33 to 50	Precision	Q11644A
WR-19	40 to 60	Precision	U11644A
WR-15	50 to 75	Precision	V11644A
WR-10	75 to 110	Precision	W11644A

Electronic Calibration Modules (ECal)

Device Connector Type	Frequency Range	Available Options	Model
Type-F (75 ohm) ¹	300 kHz to 3 GHz	00A, 00F, 00M, MOF, UK6	85099C
Type-N (75 ohm) ¹	300 kHz to 3 GHz	00A, 00F, 00M, MOF, UK6	85096C
Type-N (50 ohm) ¹	300 kHz to 9 GHz	00A, 00F, 00M, MOF, UK6	85092C
Type-N (50 ohm)	300 kHz to 18 GHz	00A, 00F, 00M, MOF, UK6	N4690B
7-16 ¹	300 kHz to 7.5 GHz	00A, 00F, 00M, MOF, UK6	85098C
7 mm ¹	300 kHz to 9 GHz		85091C
7 mm	300 kHz to 18 GHz		N4696B
3.5 mm ¹	30 kHz to 9 GHz	00A, 00F, 00M, MOF, UK6	85093C
3.5 mm	300 kHz to 26.5 GHz	00A, 00F, 00M, MOF, UK6	N4691B
PC Interface Kit ²	N/A	N/A	85097B
2.92 mm	10 MHz to 40 GHz	00A, 00F, 00M, MOF, UK6	N4692A
2.4 mm	10 MHz to 50 GHz	00A, 00F, 00M, MOF, UK6	N4693A
1.85 mm	10 MHz to 67 GHz	00A, 00F, 00M, MOF, UK6	N4694A
3.5 mm, Type-N 50 ohm, 7-16 (4-port)	300 kHz to 13.5 GHz	010, 020, UK6	N4431B
3.5 mm, Type-N 50 ohm, (4-port)	300 kHz to 18 GHz	020, 030, UK6	N4432A
3.5 mm (4-port)	300 kHz to 20 GHz	010, UK6	N4433A

¹ Modules have both USB and parallel connectors. A USB cable is supplied with the module.

² The VNA Interface Unit is connected to the ECal module(s) via another parallel cable. The VNA Interface kit is not needed with the PNA and PNA-L Series network analyzers. These analyzers control the modules directly.

Mechanical Verification Kits

Device Connector Type	Frequency Range (GHz)	Type	Available Options	Compatible Network Analyzers	Model
Type-N	30 kHz to 18	Precision		8719, 8720, 8510, PNA	85055A
7 mm	DC to 6	Precision	001**	8753	85029B
7 mm	0.045 to 18	Precision		8719, 8720, 8510, PNA	85051B
3.5 mm	30 kHz to 26.5	Precision		8719, 8720, 8510, PNA	85053B
2.4 mm	0.045 to 50	Precision		8722, 8510, PNA	85057B
1.85 mm	0.010 to 67 Hz	Precision		8510, PNA	85058V
WR-28	26.5 to 40	Precision		8510, 85106, PNA	R11645A
WR-22	33 to 50	Precision		8510, 85106, PNA	Q11645A
WR-19	40 to 60	Precision		8510, PNA	U11645A
WR-15	50 to 75	Precision		8510, 85106, PNA	V11645A
WR-10	75 to 110	Precision		8510, 85106	W11645A

Options apply to mechanical calibration, ECal, and verification kits

Option 001* Adds 2.4 mm sliding load and 2.4 mm gauges

Option 001** Adds data for 8702 lightwave component analyzer

Option 00A Adds male to male and female to female adapters

Option MOF ECal module with one male and one female connector

Option OOF ECal module with two female connectors

Option OOM ECal module with two male connectors

Option 100 Adds female to female adapter

Option 200 Adds male to male adapter

Option 300 Adds male to female adapter

Option 400 Adds series of 3.5 mm to Type-N adapters

Option 500 Adds series of 3.5 mm (or Type-N) to 7 mm adapters

UK6 Commercial calibration with measured data

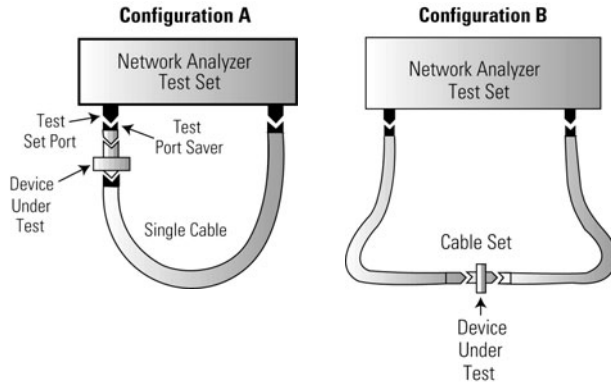
010 Four female, 3.5 mm connectors

020 Four female, Type-N 50 ohm connectors

030 Four 7 mm connectors

Cables

Test port cables provide the connection required when using network analyzers with various test devices and equipment. Test port cables are available for two test configurations as shown below. Configuration A utilizes a single test port cable for use when the device under test (DUT) is connected directly to the port on the test set. Configuration B utilizes two test port cables; which provides more flexibility since the DUT is connected between the test port cables.



In order to select a cable, find the table below that corresponds to the connector type of your network analyzer. Then, search that table for your device's connector type. If the device's connector type is not present in the table, an adapter needs to be selected to mate the test port cable to your device. Adapters may be provided in a calibration kit, or ordered separately. A full detailed list of calibration kit contents is available from the web site: www.agilent.com/find/naaccessories

50-ohm, Type-N Test Set Ports

Device Connector Type	Cable Connector Description	Model
Type-N	Type-N (m) to Type-N (m), 24 in (61 cm)	N6314A
Type-N	Type-N (m) to Type-N (f)	N6315A

75-ohm, Type-N Test Set Ports

Device Connector Type	Cable Connector Description	Model
Type-N	75 ohm, Type-N (m) to Type-N (m) 75 ohm, Type-N (m) to Type-N (f)	11857B
Type-F	75 ohm, Type-N (m) to Type-F (m) 75 ohm, Type-N (m) to Type-F (f)	11857F

7-mm Test Set Ports

Device Connector Type	Cable Connector Description	Model
7 mm	7 mm to 7 mm, qty 2	11857D

3.5-mm Test Set Ports

Device Connector Type	Cable Type	Cable Connector Description	Model
7 mm	Semi-rigid	3.5 mm (f) NMD to 7 mm 7 mm adapter set	85132C 85130B
7 mm	Semi-rigid	3.5 mm (f) NMD to 7 mm 3.5 mm (f) NMD to 7 mm	85132D
7 mm	Flexible	3.5 mm (f) NMD to 7 mm 7 mm adapter set	85132E 85130B
7 mm	Flexible	3.5 mm (f) NMD to 7 mm 3.5 mm (f) NMD to 7 mm	85132F
3.5 mm	Semi-rigid	3.5 mm (f) NMD to 3.5 mm (f) 3.5 mm adapter set	85131C 85130D
3.5 mm	Semi-rigid	3.5 mm (f) NMD to 3.5 mm (f) 3.5 mm (f) NMD to 3.5 mm (m)	85131D
3.5 mm	Flexible	3.5 mm (f) NMD to 3.5 mm (f) 3.5 mm adapter set	85131E 85130D
3.5 mm	Flexible	3.5 mm (f) NMD to 3.5 mm (f) 3.5 mm (f) NMD to 3.5 mm (m)	85131F
Type-N	NMD to 7 mm	Use with 7 mm to Type N adapters Type N adapter set	85130C

NMD is a connector type designed to mate only with the 8510, 8720 and PNA series network analyzer test ports.

2.4-mm Test Set Ports

Device Connector Type	Cable Type	Cable Connector Description	Model
7 mm	Semi-rigid	2.4 mm (f) NMD to 7 mm 7 mm adapter set	85135C 85130E
7 mm	Semi-rigid	2.4 mm (f) NMD to 7 mm 2.4 mm (f) NMD to 7 mm	85135D
7 mm	Flexible	2.4 mm (f) NMD to 7 mm 7 mm adapter set	85135E 85130E
7 mm	Flexible	2.4 mm (f) NMD to 7 mm 2.4 mm (f) NMD to 7 mm	85135F
3.5 mm	Semi-rigid	2.4 mm (f) NMD to 3.5 mm (f) 3.5 mm adapter set	85134C 85130F
3.5 mm	Semi-rigid	2.4 mm (f) NMD to 3.5 mm (f) 2.4 mm (f) NMD to 3.5 mm (m)	85134D
3.5 mm	Flexible	2.4 mm (f) NMD to 3.5 mm (f) 3.5 mm adapter set	85134E 85130F
3.5 mm	Flexible	2.4 mm (f) NMD to 3.5 mm (f) 2.4 mm (f) NMD to 3.5 mm (m)	85134F
2.4 mm	Semi-rigid	2.4 mm (f) NMD to 2.4 mm (f) 2.4 mm adapter set	85133C 85130G
2.4 mm	Semi-rigid	2.4 mm (f) NMD to 2.4 mm (f) 2.4 mm (f) NMD to 2.4 mm (m)	85133D
2.4 mm	Flexible	2.4 mm (f) NMD to 2.4 mm (f) 2.4 mm adapter set	85133E 85130G
2.4 mm	Flexible	2.4 mm (f) NMD to 2.4 mm (f) 2.4 mm (f) NMD to 2.4 mm (m)	85133F

NMD is a connector type designed to mate only with the 8510, 8720 and PNA series network analyzer test ports.

1.85-mm Test Set Ports

Device Connector Type	Cable Type	Cable Connector Description	Model
1.85 mm	Flexible	1.85 mm (f) to 1.85 mm (f) 1.85 mm adapter set	N4697C 85130H
1.85 mm	Flexible	1.85 mm (f) to 1.85 mm (f) 1.85 mm (f) to 1.85 mm (m)	N4697F

1.0-mm Test Set Ports

Device Connector Type	Cable Connector Description	Model
1.0 mm	1.0 mm (f) to 1.0 mm (f)	11500I
1.0 mm	1.0 mm (f) to 1.0 mm (m), 16 cm	11500J
1.0 mm	1.0 mm (f) to 1.0 mm (m), 20 cm	11500K
1.0 mm	1.0 mm (f) to 1.0 mm (m), 24 cm	11500L

Network Analyzer Accessories

11930A/B Power Limiters

The 11930A/B limiters protect the input circuits of network analyzers, spectrum analyzers, and sources from transients and short-duration overloads.



86205A/86207A

85024A

86205A/86207A RF Bridges

The 86205A/86207A high directivity RF bridges offer unparalleled performance in a variety of general-purpose applications. They are ideal for accurate reflection measurements and signal leveling applications.

85024A High-Frequency Probe

The 85024A high-frequency probe makes it easy to perform in-circuit measurements. An input capacitance of only 0.7 pF shunted by 1 MΩ of resistance permits high-frequency probing without adversely loading the circuit-under-test. Excellent frequency response and unity gain guarantee high accuracy in swept measurements with this probe. High probe sensitivity and low distortion levels allow measurements to be made while taking advantage of the full dynamic range of RF analyzers. RF network analyzers such as the 8753ET/ES, 8753E, 3577A, and 4195A are directly compatible. Additionally, the 8560, 8590E, and ESA series signal analyzers are also compatible. You can use the 1122A probe power supply or any dual ±15 V, 130 mA supply.

11852B 50 ohm/75 ohm Minimum Loss Pad

The 11852B is a low SWR minimum loss pad used to transform 50-ohm port impedance to 75-ohm or 75-ohm to 50-ohm.

Type-N Accessory Kits

Each kit contains a Type-N (female) short, a Type-N (male) short, two Type-N (male) barrels, two Type-N (female) barrels, and a storage case.

11853A 50-ohm Type-N Accessory Kit

Accessory kit furnishes components for measurement of devices with 50-ohm Type-N connectors.

11855A 75-ohm Type-N Accessory Kit

Accessory kit furnishes components for measurement of devices with 75-ohm Type-N connectors. This kit also contains a 75-ohm Type-N (male) termination.

11878A Type-N/3.5 mm Adapter Kit

Adapter kit contains: 3.5 (f) to Type-N (M), 3.5 (m) to Type-N (m), 3.5 (f) to Type-N (f), and 3.5 (m) to Type-N (f).

BNC Accessory Kits

The BNC accessory kit contains two Type-N (male) to BNC (female) adapters, two Type-N (male) to BNC (male) adapters, two Type-N (female) to BNC (female) adapters, two Type-N (female) to BNC (male) adapters, a BNC (male) short, and a storage case.

11854A 50-ohm BNC Accessory Kit

Accessory kit furnishes components for measurement of devices with 50-ohm BNC connectors.

11856A 75-ohm BNC Accessory Kit

Accessory kit furnishes components for measurement of devices with 75-ohm BNC connectors. This kit also contains a 75-ohm BNC (male) termination.

7-16 Adapter Kits

The 11906 family adapter kits.

11906A 7-16 to 7-16 Adapter Kit

Adapter Kit Contains:	Quantity
7-16 male to male adapter	1
7-16 female to female adapter	1
7-16 male to female adapter	2

11906B 7-16 to 50-ohm Type-N Adapter Kit

Adapter Kit Contains:	Quantity
Type-N male to 7-16 male adapter	1
Type-N female to 7-16 female adapter	1
Type-N female to 7-16 male adapter	1
Type-N male to 7-16 female adapter	1

11906C 7-16 to 7-mm Adapter Kit

Adapter Kit Contains:	Quantity
7-mm to 7-16 male adapter	2
7-mm to 7-16 female adapter	2

11906D 7-16 to 3.5-mm Adapter Kit

Adapter Kit Contains:	Quantity
3.5-mm male to 7-16 male adapter	1
3.5-mm female to 7-16 female adapter	1
3.5-mm female to 7-16 male adapter	1
3.5-mm male to 7-16 female adapter	1

1.0 mm Test Port Connectors

Adapters	Connector Type
11920A/B/C ¹ adapters	1.0 mm series adapters
11921A/B/C/D ¹ adapters	1.0 mm to 1.85 mm series adapters
11922A/B/C/D ¹ adapters	1.0 mm to 2.4 mm series adapters
11923A adapters	1.0 mm (f) to circuit card launch
V281C/D ² adapters	1.0 mm to V-band waveband guide
W281C/D ² adapters	1.0 mm to W-band waveband guide

¹ Suffix 'A' denotes male-to-male, 'B' denotes female-to-female, 'C' denotes male-to-female and 'D' denotes female-to-male.

² Suffix 'C' denotes 1.0 mm female and 'D' denotes 1.0 mm male.

Ordering Information

11930A/B Power Limiters

86205A/86207A RF Bridges

85024A High-Frequency Probe

11852B 50-ohm/75-ohm Minimum Loss Pad

Type-N Accessory Kits

11853A 50-ohm Type-N Accessory Kit

11855A 75-ohm Type-N Accessory Kit

11878A Type-N/3.5 mm Adapter Kit

BNC Accessory Kits

11854A 50-ohm BNC Accessory Kit

11856A 75-ohm BNC Accessory Kit

7-16 Adapter Kits

11906A 7-16 to 7-16 Adapter Kit

11906B 7-16 to 50-ohm Type-N Adapter Kit

11906C 7-16 to 7-mm Adapter Kit

11906D 7-16 to 3.5-mm Adapter Kit

- Select from a wide range of models to get the measurement capability for your specific application
- Configure for individual or team needs
- Identify problems quickly with intuitive triggering
- Access signals easily and make accurate measurements with reliable probing solutions

Fast, Accurate Answers Throughout the Design Validation Cycle

Agilent’s logic analyzers help minimize your project risk by providing the most reliable, accurate data capture and the most complete view of system behavior. A comprehensive family of products offers a variety of form factors, acquisition speeds, memory depths, channel counts, and application-specific analysis and protocol tools to create a solution that will meet your toughest digital debug needs.



16900 Series
16800 Series

Selection Guide for Logic Analysis Solutions

Product	16800 Series Portable Logic Analyzers	16900 Series Modular Logic Analysis Systems
Form Factor	A fixed configuration with built-in 15" (38.1 cm) color display, touch screen available. Use for single or dual bus analysis. Models available with built-in 48-channel pattern generator	A configurable system with 2 to 6 slots offers the most flexibility and the highest performance for multiple bus analysis. Use with either built-in 15" (38.1 cm) color touch display or external monitor
Timing Speeds	Up to 4 GHz	Up to 4 GHz
State Speeds	Up to 500 Mb/s	Maximum ranges from 250 MHz up to 1.5 Gb/s
Memory Depth	Up to 32 M	Up to 256 M (512 M in half channel)
Channels	34, 68, 102, 136, 204	From 34 up to 9,782
Additional Considerations	Probes and accessories; Wide variety of processor, bus, FPGA and protocol solutions; View Scope for integrated measurements and analysis with Agilent oscilloscopes; Optional application and analysis software packages	

Accessories

1181BZ Testmobile System Cart

Key Literature & Web Link

Agilent Technologies 16900 Series Logic Analysis Systems Brochure, p/n 5989-0420EN
Agilent 16900 Series Logic Analysis System Mainframes Data Sheet, p/n 5989-0421EN
Agilent 16800 Series Portable Logic Analyzers Brochure, p/n 5989-5062EN
Agilent 16800 Series Portable Logic Analyzers Data Sheet, p/n 5989-5063EN

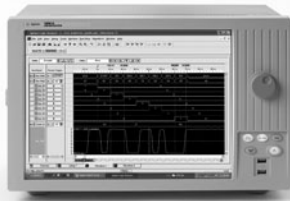
www.agilent.com/find/logic
www.agilent.com/find/logicdemos

16901A
16902A

- **Protect your investment by purchasing a system with the capability you need now, then expand as your needs evolve**
- **View cross-domain measurements, correlated in time**
- **Set up measurements easily and navigate through your data quickly with the analyzer's intuitive user interface and touch screen display**
- **Achieve the fastest logic analyzer control and analysis in the industry with Hosted Power Mode. The multi-threading architecture takes full advantage of Gbit LAN and the most current multi-processor, large memory computer technology**
- **Increase your productivity and maximize your analyzer's usage whether you work at your bench or with team members distributed around the world. Use models include offline analysis, remote control and programmability, extended desktop viewing across multiple monitors, and multi-frame configurations**



2 and 6-slot modular logic analysis systems



Large 15" (38.1 cm) color display with touch screen

Specifications

Product	16902A Logic Analysis System	16901A Logic Analysis System
Module Slots	6	2
PCI Expansion Slots	1 full profile, 1 low profile	1 full profile
Display and Resolution	Built-in 12.1 inch color touch screen, 800 x 600	Built-in 15" (38.1 cm) color touch screen, 1024 x 768
I/O and Storage	2 USB ports (ver 1.1), 10/100 Base-T, parallel port, 80 GB hard drive, external SVGA display port, Trigger In and Trigger Out BNCs	Six USB 2.0 ports, Gbit LAN, parallel port, 80 GB hard drive (external removable hard drive available), external SVGA display port, Trigger In and Trigger Out BNCs
Additional Capabilities	Wide variety of processor, bus and FPGA solutions; View Scope for time-correlated, integrated measurements and analysis with Agilent oscilloscopes; Optional software packages	

Get the Performance You Need at a Price to Match Your Budget

The Agilent 16900 Series logic analysis systems provide high-performance, system-level debugging of digital designs. Configure a system for your specific needs with innovative probing, high-performance measurement modules, and post-processing analysis tools.

Accessories

E5861A Multiframe cable. Order 1 less than the number of frames to be connected

16901A-109 External Removable Hard Drive

16902A-109 External Removable Hard Drive

1181BZ Testmobile System Cart

A wide-range of processor, bus and FPGA support

www.agilent.com/find/pnbs

www.agilent.com/find/logic-sw-apps

Key Literature & Web Link

Agilent Technologies 16900 Series Logic Analysis System Brochure, p/n 5989-0420EN

Agilent Technologies 16900 Series Logic Analysis System Mainframes Data Sheet, p/n 5989-0421EN

Agilent Technologies Measurement Modules for the 16900 Series Data Sheet, p/n 5989-0422EN

www.agilent.com/find/16900

Ordering Information

A complete system consists of a logic analyzer mainframe, measurement modules, probes and optional application and analysis software. Refer to pages 181, 182, 185-190 for additional information on measurement modules, probes and optional application and analysis software.

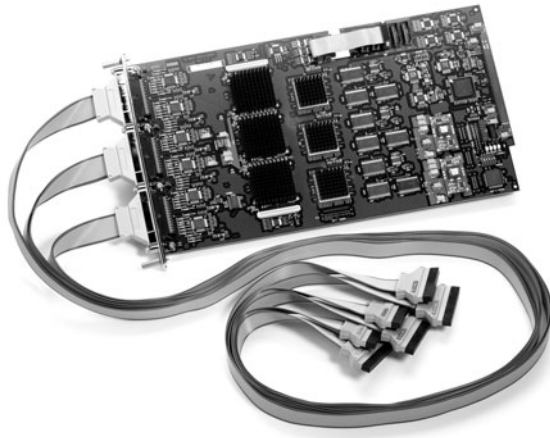
16901A 2-slot Logic Analyzer Mainframe

16901A-109 External Removable Hard Drive

16902A 6-slot Logic Analyzer Mainframe

16902A-109 External Removable Hard Drive

- Choose from a wide variety of timing/state analyzers, pattern generator or oscilloscopes
- Acquire 4 GHz timing zoom, state analysis up to 1.5 Gb/s, memory depths up to 512 M samples
- Sample high-speed synchronous buses accurately and confidently with eye finder
- Identify problem signals quickly by viewing eye diagrams across all buses and signals simultaneously with eye scan
- Capture either single-ended or differential signals
- Upgrade your memory depth and state speed as your needs change



Configure Custom Measurement Solutions for Demanding Applications

Agilent Technologies offers robust measurement modules for digital analysis as well as target stimulus. Create a custom solution or expand your existing analysis system by selecting one or more timing/state analyzer modules or pattern generator modules to meet your validation needs.

Accessories

16910A and 16911A module cables end with 40-pin cable connectors and are compatible with 40-pin probes. 16950B, 16951B and 16760A module cables end with 90-pin cable connectors and are compatible with 90-pin probes.

www.agilent.com/find/logic_analyzer_probes

A wide range of processor, bus, FPGA and application packages are available. www.agilent.com/find/pnbs

Key Literature & Web Link

Agilent Technologies Measurement Modules for the 16900 Series, p/n 5989-0422EN

www.agilent.com/find/16900

Ordering Information

16910A and 16911A – Specify desired state speed and memory depth options when ordering

16950B – Specify desired memory depth option when ordering

Upgrades

To increase memory depth or state speed after initial purchase, specify the desired state speed and memory depth options for the following upgrade model numbers:

E5865A for upgrading an existing 16910A

E5866A for upgrading an existing 16911A

E5875A for upgrading an existing 16950B

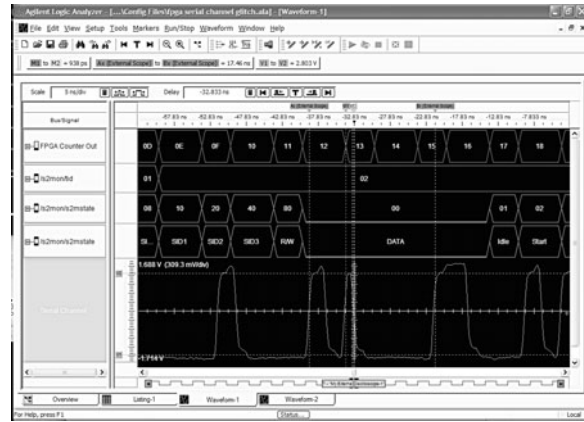
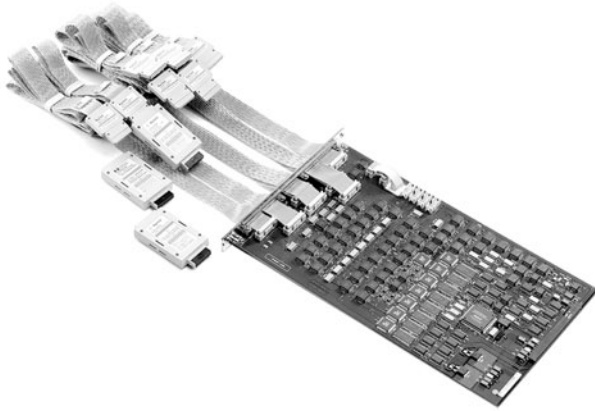
Probes are ordered separately. Choose a probe type that fits your application.

www.agilent.com/find/logic_analyzer_probes

Selection Guide for Logic Analyzer Modules

Product	16910A	16911A	16950B	16951B	16760A
Channels per Module	102	68	68	68	34
Max. Channels on a Single Timebase & Trigger	510	340	340	340	170
Memory Depths (Memory depth doubles in half-channel timing)	256 K: Option 256 1 M: Option 001 4 M: Option 004 16 M: Option 016 32 M: Option 032	256 K: Option 256 1 M: Option 001 4 M: Option 004 16 M: Option 016 32 M: Option 032	1 M: Option 001 4 M: Option 004 16 M: Option 016 32 M: Option 032 64 M: Option 064	256 M	64 M
High Speed Timing Rate	4 GHz (250 ps) with 64 K depth	4 GHz (250 ps) with 64 K depth	4 GHz (250 ps) with 64 K depth	4 GHz (250 ps) with 64 K depth	—
Max Deep Memory Timing Sample Rate (half/full channel)	1.0 GHz (1.0 ns)/ 500 MHz (2.0 ns)	1.0 GHz (1.0 ns)/ 500 MHz (2.0 ns)	1.2 GHz (833 ps)/ 600 MHz (1.67 ns)	1.2 GHz (833 ps)/ 600 MHz (1.67 ns)	800 MHz (1.25 ns)
Transitional Timing	500 MHz (2.0 ns)	500 MHz (2.0 ns)	600 MHz (1.67 ns)	600 MHz (1.67 ns)	400 MHz (2.5 ns)
Max. State Clock Rate	250 MHz (Option 250) 450 MHz (Option 500)	250 MHz (Option 250) 450 MHz (Option 500)	667 MHz	667 MHz	800 MHz
Max. State Data Rate	250 Mb/s (Option 250) 500 Mb/s (Option 500)	250 Mb/s (Option 250) 500 Mb/s (Option 500)	1066 Mb/s	1066 Mb/s	1.5 Gb/s
Voltage Threshold Ranges	–5 V to 5 V (10 mV increments)	–5 V to 5 V (10 mV increments)	–3 V to 5 V (10 mV increments)	–3 V to 5 V (10 mV increments)	–3 V to 5 V (10 mV increments)
Automated Threshold/Sample Position, Simultaneous Eye Diagrams on All Channels	Yes	Yes	Yes	Yes	Yes
Supported Signal Types	Single-ended	Single-ended	Single-ended & differential	Single-ended & differential	Single-ended & differential
Probe Compatibility	40-pin Cable Connector	40-pin Cable Connector	90-pin Cable Connector	90-pin Cable Connector	90-pin Cable Connector
Probe Loading	<0.7pF with soft touch connectorless probing				

16720A
View Scope



Digital Stimulus for Performing Functional Verification, Debugging and Stress Testing

The Agilent 16720A digital pattern generator module for Agilent's 16900 Series logic analysis systems is ideal for the functional testing of your digital design. The pattern generator is used to simulate infrequently encountered test conditions in hardware design and software program testing. You can also use a pattern generator to stimulate your electronic designs with ideal or faulty digital patterns for performing functional verification, debugging and stress testing.

Agilent 16720A Pattern Generator Module

	Half Channels	Full Channel
Maximum Clock Speed	300 MHz	180 MHz
Memory Depth in Vectors	16 M	8 M
Maximum Number of Channels per Timebase	24	48
Maximum Vector Width	120 bits	240 bits
Stimulus Commands	Initialize, block, repeat, and break macros	
Logic Levels Supported	5 V TTL, 3-state TTL, 3-state CMOS, 3-state 3.3 V, ECL, 5 V PECL, 3.3 V LVPECL, 3-state 2.5 V, 3-state 1.8 V, LVDS	

Accessories

Pod Options for 16720A Pattern Generator

- Option 011** TTL clock pod & lead set
- Option 013** 3-state TTL/CMOS data pod & lead set
- Option 014** TTL data pod & lead set
- Option 015** 2.5 V clock pod & lead set
- Option 016** 2.5 V 3-state data pod & lead set
- Option 017** 3.3 V clock pod & lead set
- Option 018** 3.3 V 3-state data pod & lead set
- Option 021** ECL clock pod & lead set
- Option 022** ECL (terminated) data pod & lead set
- Option 023** ECL (unterminated) data pod & lead set
- Option 031** 5 V PECL clock pod & lead set
- Option 032** 5 V PECL data pod & lead set
- Option 033** 3.3 V LVPECL clock pod & lead set
- Option 034** 3.3 V LVPECL data pod & lead set
- Option 041** 1.8 V clock pod & lead set
- Option 042** 1.8 V 3-state data pod & lead set
- Option 051** LVDS clock pod & lead set
- Option 052** LVDS data pod & lead set

Ordering Information

When ordering the 16720A, please note the following:
You must order at least one clock pod for each 16720A module used as a master. You must order at least one data pod for every 8 output channels. The 10483 is the recommended replacement for the discontinued 10466A.

Unleash the Complementary Power of a Logic Analyzer and an Oscilloscope

Easily make time-correlated measurements between an Agilent logic analyzer and oscilloscope. The time-correlated logic analyzer and oscilloscope waveforms are integrated into a single logic analyzer waveform display for easy viewing and analysis.

Specifications

View Scope Features, Connection and Compatibility

View Scope Capabilities Include

- Automatic de-skew of the waveforms
- Trigger the oscilloscope from the logic analyzer (or vice versa)
- Precisely relate information on the instrument displays with tracking markers
- Maintain tight time-correlation across deep memory acquisitions with synchronized sampling clocks

Logic Analyzer/Oscilloscope Connection

- Use standard LAN connection and two BNC cables to connect Trigger In and Trigger Out

Agilent Oscilloscope Capabilities

- Maximum Scope Bandwidth: 13 GHz
- Maximum Sampling Rate: 40 GSa/s
- Maximum Memory Depth: 128 M points
- Channels per Oscilloscope: 2 and 4

Compatible Agilent Oscilloscopes

- 80000B Infiniium Series High Performance Lab Oscilloscopes
- 8000 Infiniium Series General Purpose Lab Oscilloscopes
- 6000 Series High-performance Portable Oscilloscopes
- 5000 Series Portable Oscilloscopes

Compatible Logic Analyzers

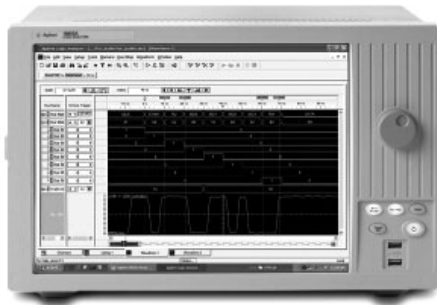
- 16800 Series Portable Logic Analyzers
- 16900 Series Modular Logic Analyzers
- 1690 Series PC-hosted Logic Analyzers
- 1680 Series Logic Analyzers

Key Literature & Web Link

Agilent Technologies Measurement Modules for the 16900 Series Data Sheet, p/n 5989-0422EN
Agilent Technologies 16900 Series Logic Analysis System Mainframes Data Sheet, p/n 5989-0421EN
View Scope Logic Analyzer and Oscilloscope Correlation Data Sheet, p/n 5989-4646EN

www.agilent.com/find/logic_modules

- 15-inch (38.1 cm) color display (touch screen available) allows you to see more data and gain insight quickly
- Up to 32 M memory depth enables you to identify the root cause of a problem widely separated in time from the symptom
- Models with a built-in pattern generator allow you to verify operation across a variety of test conditions
- Set up measurements easily and navigate through your data quickly with the analyzer's intuitive interface
- Meet your application and budget needs by selecting configurations that range from 34 to 204 channels



Advanced Measurements for Your Digital Applications at a Price that will Fit Your Budget

16800 Series portable logic analyzers offer the performance, applications, and usability your digital development team needs to quickly debug, validate, and optimize your digital system. Meet your application and budget needs by selecting from eight models that range from 34 to 204 channels.

Accurately measure precise timing relationships over longer periods of time with 4 GHz (250 ps) timing zoom at 64 K deep. Find anomalies separated in time with memory depths upgradeable to 32 M. You get it all at a price that fits your budget.

Models with an integrated pattern generator let you control and monitor real-time system operation. Drive down risk early in product development by replacing missing circuits or boards with digital stimulus. Verify operation across a variety of test conditions with normal or faulty digital patterns at full speed or by stepping through individual states.

16801A
16802A
16803A
16804A
16806A
16821A
16822A
16823A

Selection Guide for 16800 Series Portable Logic Analyzers

Product	16801A/16821A	16802A/16822A	16803A/16823A	16804A	16806A
Logic Analyzer Channels	34	68	102	136	204
Pattern Generator Channels	48 (16821A)	48 (16822A)	48 (16823A)	—	—
High-speed Timing Zoom	4 GHz (250 ps) with 64 K depth	4 GHz (250 ps) with 64 K depth			
Maximum Timing Sample Rate (Half/Full Channel)	1.0 GHz (1.0 ns)/ 500 MHz (2.0 ns)	1.0 GHz (1.0 ns)/500 MHz (2.0 ns)			
Transitional Timing	500 MHz	500 MHz			
Maximum State Clock Rate	250 MHz with option 250	450 MHz with option 500 250 MHz with option 250			
Maximum State Data Rate	250 Mb/s with option 250	500 Mb/s with option 500 250 Mb/s with option 250			
Maximum Memory Depth	1 M with option 001 4 M with option 004 16 M with option 016 32 M with option 032	1 M with option 001 4 M with option 004 16 M with option 016 32 M with option 032			
Supported Signal Types	Single-ended				
Automated Threshold/Sample Position, Simultaneous Eye Diagrams on All Channels	Yes				
Probe Compatibility	40-pin cable connector				
Probe Loading	< 0.7 pF with soft touch connectorless probing				
Display	15-inch (38.1 cm) color display with touch screen available				
I/O and Storage	Six 2.0 USB ports (2 on front panel, 4 on rear panel), Gbit LAN, parallel port, 80 GB hard drive, mouse and keyboard, Trigger In & Trigger Out BNCs				
Additional Capabilities	View Scope; A wide range of processor, bus and FPGA support; Optional analysis software packages; email on trigger; offline analysis, remote programmatic control via COM or ASCII RPI				

Pattern Generator Specifications and Characteristics

Product	16821A/16822A/16823A	
	Half Channel	Full Channel
Maximum Clock	300 MHz	180 MHz
Data Channels	24	48
Memory Depth in Vectors	16 M	8 M
Logic Levels Supported	5 V TTL, 3-state TTL, 3-state TTL/CMOS, 3-state 1.8 V, 3-state 2.5 V, 3-state 3.3 V, ECL, 5 V PECL, 3.3 V LVPECL, LVDS	

Logic Analyzers

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16800 Series Portable Logic Analyzers (cont.)

Accessories

16800 Series portable logic analyzers have 40-pin cable connectors. The following 40-pin probes are compatible with the 16800 Series. Probes are ordered separately.

www.agilent.com/find/logic_analyzer_probes

General Purpose Flying Lead Probe

17-ch E5383A

Connector Probes

Mictor: 34-ch E5346A

Samtec: 34-ch E5385A

Connectorless Probes

17-ch E5396A soft touch

34-ch E5394A soft touch

34-ch E5404A pro-series soft touch

Key Literature & Web Link

Agilent 16800 Series Portable Logic Analyzers Brochure, p/n 5989-5062EN

Agilent 16800 Series Portable Logic Analyzers Data Sheet, p/n 5989-5063EN

www.agilent.com/find/logic

Ordering Information

A complete system consists of a 16800 Series logic analyzer, probes and any additional application software.

Options

The following options apply to all 16800 Series logic analyzers:

16800A-102 Front Panel with 15" Display

16800A-103 Front Panel with 15" Display and Touch Screen

16800A-101 Internal Hard Drive

16800A-109 External Removable Hard Drive

16800 Series model number-001 1 M Memory Depth

16800 Series model number-004 Increase Memory Depth to 4 M

16800 Series model number-016 Increase Memory Depth to 16 M

16800 Series model number-032 Increase Memory Depth to 32 M

16800 Series model number-250 Maximum State Speed of 250 MHz

16800 Series model number-500 Increase Maximum State Speed to 500 Mb/s (Option 500 applies to 16802A, 16803A, 16804A, 16806A, 16822A and 16823A)

40-pin Probes Compatible with the 16800 Series

General Purpose Flying Lead Probe

17-ch E5383A

Connector Probes

Mictor: 34-ch E5346A

Samtec: 34-ch E5385A

Connectorless Probes

17-ch E5396A soft touch

34-ch E5394A soft touch

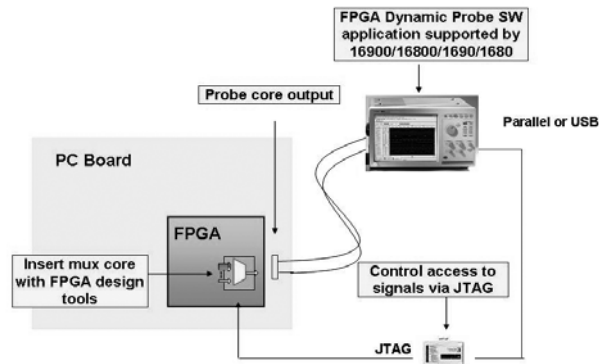
34-ch E5404A pro-series soft touch

Pattern Generator Clock and Data Pods See page 182 for details

Upgrades

To increase memory depth or state speed after initial purchase, order the following:

Product	16801A/16821A	16802A/16822A	16803A/16823A	16804A	16806A
Increase Memory Depth to 4 M	E5876A-004	E5877A-004	E5878A-004	E5879A-004	E5880A-004
Increase Memory Depth to 16 M	E5876A-016	E5877A-016	E5878A-016	E5879A-016	E5880A-016
Increase Memory Depth to 32 M	E5876A-032	E5877A-032	E5878A-032	E5879A-032	E5880A-032
Increase State Speed to 500 Mb/s	—	E5877A-500	E5878A-500	E5879A-500	E5880A-500



Quickly Debug Your FPGA and Surrounding System with X-ray Vision for Your FPGAs

B4655A FPGA Dynamic Probe for Xilinx

- Gain visibility into the internal activity of your Xilinx FPGAs. Access up to 128 internal signals for each pin dedicated to debug
- Switch internal probe points in seconds to measure a different set of internal signals without changing your FPGA design
- Leverage the work you did in your design environment. The FPGA dynamic probe maps internal signal names from your ISE design software to the logic analyzer. Automated bus name and signal setup eliminates mistakes and saves time
- Supported Xilinx devices: Virtex-5 series, Virtex-4 series, Virtex-II Pro series, Virtex-II series, Spartan-3 series

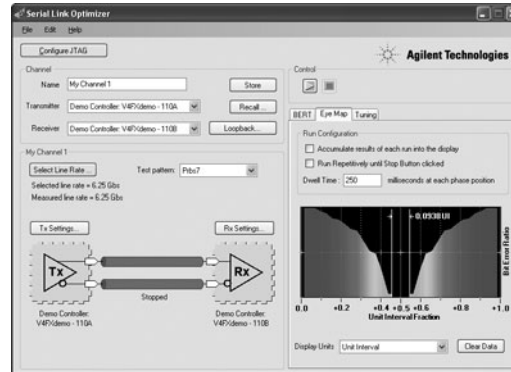
E9524A MicroBlaze Trace Toolset

Easily trace MicroBlaze software execution with Agilent's MicroBlaze trace core and inverse assembler

- Capture real-time code flow from one or more MicroBlaze cores
- Time correlate MicroBlaze activity with measurements from the surrounding system
- Display processor execution in assembly instruction mnemonics correlated to high-level source code
- Supports instruction-side and/or data-side decoding
- Supported Xilinx devices: Virtex-5 series, Virtex-4 series, Virtex-II Pro series, Virtex-II series, Spartan-3 series

B4656A FPGA Dynamic Probe for Altera

- Gain visibility into the internal activity of your Altera FPGAs. Access up to 256 internal signals for each pin dedicated to debug
- Switch internal probe points in seconds to measure a different set of internal signals without changing your FPGA design
- Leverage the work you did in your design environment. The FPGA dynamic probe maps internal signal names from your Quartus design software to the logic analyzer. Automated bus name and signal setup eliminates mistakes and saves time
- Altera device support: Stratix series, Cyclone series, MAX series, APEX series, and Excalibur series



Automatically Tune Your Xilinx MGT-based Serial Links for Optimal Performance

E5910A Serial Link Optimizer for Xilinx FPGAs

Agilent's Serial Link Optimizer is a software tool that extends the Xilinx ChipScope Pro Serial IO Toolkit and provides easy-to-use BERT, eye mapping, and automatic channel tuning for optimal bit error ratio on your gigabit serial bus implemented with Xilinx FPGAs.

The Serial Link Optimizer is used together with the internal bit error ratio tester (IBERT) core from the Xilinx ChipScope Pro Serial IO Toolkit. This extended analysis and automatic optimization capability saves you considerable time and expense in optimizing the BER of your serial link.

- Graphical margin analysis with eye mapping
- Automatic optimization of your serial link's BER
- On-chip measurements via JTAG means no external instrumentation
- Available from Xilinx worldwide distributors Avnet and Nu Horizons
- Supported Xilinx devices: Virtex-4 FX, Virtex-5 LXT and SXT

Key Literature & Web Link

Agilent Technologies B4655A FPGA Dynamic Probe for Xilinx Data Sheet, p/n 5989-0423EN
 Agilent Technologies FPGA Dynamic Probe FAQs for Xilinx Data Sheet, p/n 5989-1170EN
 Agilent Technologies B4656A FPGA Dynamic Probe for Altera Data Sheet, p/n 5989-5595EN
 Agilent Technologies FPGA Dynamic Probe FAQs for Altera Data Sheet, p/n 5989-5716EN
 Agilent E9524A MicroBlaze Trace Toolset Data Sheet, p/n 5989-5187EN
 Agilent E5910A Serial Link Optimizer for Xilinx FPGAs Data Sheet, p/n 5989-5969EN
 Testing and Optimizing High-Speed Serial Links with the Agilent E5910A Serial Link Optimizer Technical Overview, p/n 5989-6048EN

www.agilent.com/find/fpga
www.agilent.com/find/serial_io

Ordering Information

B4655A FPGA Dynamic Probe for Xilinx
 Option 011 Perpetual Node Locked License
 Option 012 Perpetual Floating (server) License
B4656A FPGA Dynamic Probe for Altera
 Option 010 Perpetual Node Locked License
 Option 020 Perpetual Floating (server) License
E5910A Serial Link Optimizer
 Option 010 1-year Node Locked License
 Option 020 1-year Floating (server) License
E9524A MicroBlaze Trace Toolset
 Option 010 Perpetual Node Locked License
 Option 020 Perpetual Floating (server) License

B4655A
 B4656A
 E9524A
 E5910A

Logic Analyzers

186 Probing Solutions for Logic Analyzers with 40-pin Cable Connectors

E5346A
E5383A
E5385A
E5394A
E5396A
E5404A

- Easily connect with reliable, electrically and mechanically unobtrusive probing solutions
- Achieve low loading (<0.7 pF), an easy connection and a small footprint with soft touch connectorless probes
- Save time making bus- and processor-specific measurements with application specific analysis probes

Accurate Measurements Start with Reliable Probing

Your logic analyzer measurement is only as reliable as your probing. Agilent offers a wide variety of probing accessories that support general-purpose and application specific measurement needs. The probes provide a robust, reliable connection between your Agilent logic analyzer and the system under test. They are easy to connect and are electrically and mechanically unobtrusive, giving you unsurpassed measurement accuracy.

Key Literature & Web Link

Probing Solutions for Logic Analyzers Catalog, p/n 5968-4632E
Application Support for Agilent Logic Analyzers, p/n 5966-4365E
www.agilent.com/find/logic_analyzer_probes



Soft Touch Connectorless

Samtec



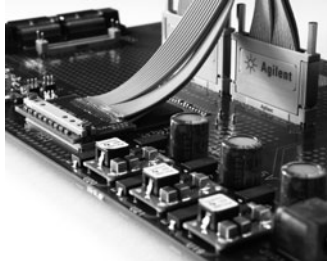
Mictor

Flying Lead Set

Selection Guide for Agilent Logic Analyzer Probing Solutions (For Logic Analyzers with 40-pin Cable Connector)

Compatible with 16800 Series, 16910/11A, 16750/51/52A/B, 1674x Series, 1671x Series, 165xx Series modules, 1690 Series, 1680 Series, 1670 Series, 1660 Series, 1650 Series and E9340A logic analyzers

Product	Soft Touch Connectorless Probes			Samtec Probe	Mictor Probe	General Purpose Flying Lead Set
	E5396A	E5404A	E5394A	E5385A	E5346A	E5383A
Application	Quick connection to many channels in a small footprint without a header designed into the target			Quick connection to many signals in a small footprint	Quick connection to many signals in a small footprint	Flexible connection to individual signals
Number of Channels	17 16 data, 1 clock	34 32 data, 2 clock	34 32 data, 2 clock	34 32 data, 2 clock	34 32 data, 2 clock	17 16 data, 1 clock
Supported Signal Types	Single-ended clock, Single-ended data					
Maximum Data Rate	>2.5 Gb/s	>2.5 Gb/s	>2.5 Gb/s	1.5 Gb/s	Equivalent to the logic analyzer data rate the probe is attached to	Equivalent to the logic analyzer data rate the probe is attached to
Minimum Signal Amplitude	500 mV p-p	500 mV p-p	500 mV p-p	500 mV p-p	500 mV p-p	600 mV p-p
Connection to Target System	Requires half-size soft touch footprint designed into the target	Requires Pro Series soft touch footprint designed into the target	Requires original soft touch footprint designed into the target	Requires 100-pin Samtec connector designed into target system	Requires 38-pin Mictor connector designed into target system	Compatible with a wide assortment of accessories to connect to individual leads
Input Capacitance	<0.7 pF	<0.7 pF	<0.7 pF	1.5 pF	3.0 pF	1.5 pF



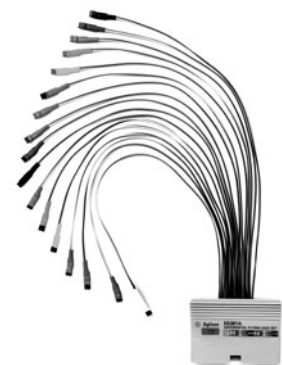
Soft Touch Connectorless



Samtec



Mictor



Flying Lead Set

E5387A
E5390A
E5398A
E5402A
E5405A
E5406A
E5378A
E5379A
E5380A
E5381A
E5382A

Selection Guide for Agilent Logic Analyzer Probing Solutions

(For Logic Analyzers with 90-pin Cable Connector)

Compatible with 16951B, 16950B, 16950A, 16760A, 16756A, 16755A, 16754A, 16753A

Product	Soft Touch Connectorless Probes				
	E5398A	E5406A, E5402A (low profile)	E5390A	E5405A	E5387A
Application	Quick connection to many channels in a small footprint without a header designed into the target				
Number of Channels	17 16 data, 1 clock	34 32 data, 2 clock	34 32 data, 2 clock	17 16 data, 1 clock	17 16 data, 1 clock
Supported Signal Types	Differential or Single-ended clock, Single-ended data	Differential or Single-ended clock, Single-ended data	Differential or Single-ended clock, Single-ended data	Differential or Single-ended clock, Differential or Single-ended data	Differential or Single-ended clock, Differential or Single-ended data
Maximum Data Rate	>2.5 Gb/s	>2.5 Gb/s	>2.5 Gb/s	>2.5 Gb/s	>2.5 Gb/s
Minimum Signal Amplitude	250 mV p-p	250 mV p-p	250 mV p-p	$V_{max} - V_{min}$ 200 mV	$V_{max} - V_{min}$ 200 mV
Connection to Target System	Requires half-size soft touch footprint designed into the target	Requires Pro Series soft touch footprint designed into the target system	Requires original soft touch footprint designed into the target system	Requires Pro Series soft touch footprint designed into the target system	Requires original soft touch footprint designed into the target system
Input Capacitance	<0.7 pF	<0.7 pF	<0.7 pF	<0.7 pF	<0.7 pF

Model Number	Samtec Probes		Mictor Probe	General Purpose Flying Lead Sets	
	E5378A	E5379A	E5380A	E5382A	E5381A
Application	Quick connection to many channels in a small footprint	Quick connection to many channels in a small footprint	Quick connection to many channels in a small footprint	Flexible connection to individual signals	Flexible connection to individual signals
Number of Channels	34 32 data, 2 clock	17 16 data, 1 clock	34 32 data, 2 clock	17 16 data, 1 clock	17 16 data, 1 clock
Supported Signal Types	Differential or Single-ended clock, Single-ended data	Differential or Single-ended clock, Differential or Single-ended data	Single-ended clock, Single-ended data	Differential or Single-ended clock, Single-ended data	Differential or Single-ended clock, Differential or Single-ended data
Maximum Data Rate	1.5 Gb/s	1.5 Gb/s	600 Mb/s	1.5 Gb/s	1.5 Gb/s
Minimum Signal Amplitude	250 mV p-p	$V_{max} - V_{min}$ 200 mV	300 mV p-p	250 mV p-p	$V_{max} - V_{min}$ 200 mV
Connection to Target System	Requires 100-pin Samtec connector designed into the target system	Requires 100-pin Samtec connector designed into the target system	Requires 38-pin Mictor connector designed into the target system	Compatible with a wide assortment of accessories to connect to individual leads	Compatible with a wide assortment of accessories to connect to individual leads
Input Capacitance	1.5 pF	1.5 pF	3.0 pF	1.3 pF	0.9 pF

Note: E5386A half-channel transition adapter provides transition between probes and 16760A logic analyzer cables. Use to reduce the number of probes and connectors required to run in half-channel mode. Adapter maps even channels to all pins of an E5378A, E5379A, E5387A, E5390A, E5402A, E5405A or E5406A. It supports differential or single-ended clock, differential or single-ended data.

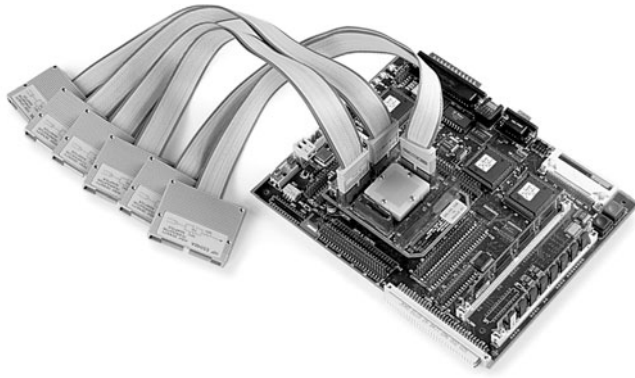
Key Literature & Web Link

Probing Solutions for Logic Analyzers Catalog, p/n 5968-4632E
Application Support for Agilent Logic Analyzers, p/n 5966-4365E

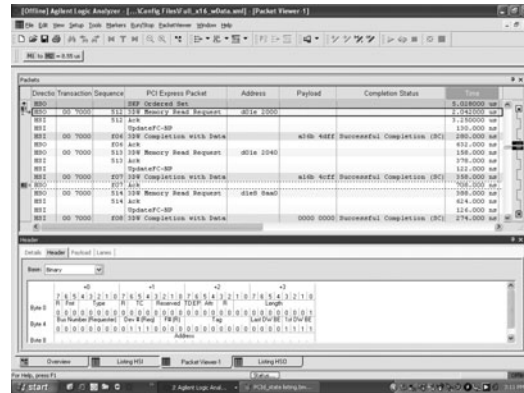
www.agilent.com/find/logic_analyzer_probes

Processor Support
Bus Support
FPGA Support
Protocol Support

- Display processor mnemonics or bus cycle decode
- Get control over your FPGA's internal and external data
- Save time making bus- and processor-specific measurements with application-specific analysis probes that quickly and reliably connect to your device under test
- Select from a comprehensive coverage of industry-standard processors and buses



- Become more productive with industry standard and proprietary protocol support that allows you to trigger, view, search and analyze at the packet level



Save Time Analyzing Your Unique Design with a Turnkey Logic Analyzer Setup

Agilent Technologies and our partners provide an extensive range of quality tools that offer non-intrusive, full-speed, real-time analysis to accelerate your debugging process.

Available Device Support

Microprocessor/Microcontrollers

AMD, Analog Devices, ARM, AT&T, Dallas, DEC, Freescale, GTE, IBM, IDT, Infineon, Intel, LSI Logic, McDonnell Douglas, MIPS, Motorola, National, NEC, PACE, PMC Sierra/QED, Rockwell, Siemens, Texas Instruments, Toshiba, Zilog

FPGAs

Xilinx devices: Virtex-5 series, Virtex-4 series, Virtex-II Pro series, Virtex-II series, Spartan-3 series

Altera devices: Stratix series, Cyclone series, MAX series, APEX series, and Excalibur series

I/O Buses

PCI, PCI-X®, PCI-Express, Serial ATA (SATA 1 and 2), SCSI, Serial Attached SCSI (SAS), Serial RapidIO, Parallel RapidIO, HyperTransport

Memory Buses

DDR1, DDR2, PC-100/133, GDDR3, Fully Buffered DIMM (FB-DIMM), Rambus

Serial Buses

CAN, Fibre Channel, FlexRay, I²C, IEEE-488, IEEE-1394, RS-232, Serial ATA (SATA 1 and 2), Serial Peripheral Interface (SPI), Serial RapidIO, System Packet Interface Level 4 (SPI 4.2), USB 2.0/1.1, PCI-Express

Graphics Buses

AGP2x, AGP4x, AGP3.0, PCI-Express

Protocol Solutions for Industry Standard and Proprietary Buses

With Agilent's packet viewer you can quickly gain insight into your system in a familiar protocol format whether you're using Agilent's solutions for industry standard protocols or our B4641A Protocol Development Kit to create a solution for your proprietary protocol. These powerful tools provide non-intrusive probing plus logic analysis triggering and decoding at the packet level. They also enable correlated analysis and sequenced event triggering across multiple buses for virtually every type of bus, making it easy to follow transactions, data, and packets as they flow through an entire system.

Logic analyzer protocol solutions include support for:

- PCI Express
- Advanced Switching Interface
- Serial ATA (SATA) and Serial Attached SCSI (SAS)
- Serial RapidIO
- Parallel RapidIO
- SPI 4.2 (System Packet Interface, POS PHY L4)
- InfiniBand
- FlexRay
- SPI (Serial Peripheral Interface)
- I²C

PCI-Express 2 Protocol Analysis

With the P2L (Protocol to Logic) gateway, you get a unique logic analyzer and Protocol functionality for PCI-Express 2 in a single solution. With this connection you can perform time-correlated cross bus measurements and cross triggering. Both the logic analyzer and protocol analyzer can be operated from a single PC. For more details, please refer to page 192.

Key Literature & Web Link

Application Support for Agilent Logic Analyzers Configuration Guide, p/n 5966-4365E

www.agilent.com/find/pnbs

www.agilent.com/find/logic-sw-apps

www.agilent.com/find/pcie2

Ordering Information

Contact Agilent if you do not see support for your specific vendor or device. A representative can:

- Determine if support is under development
- Recommend third parties that design custom solutions
- Direct you to information or consultants that can help you design a test solution

- Independently validate your DigRF v3-based BB-IC and RF-IC
- Rapidly deploy DigRF v3-based designs using Agilent's integrated and cross-correlated logic analysis and RF tools



Meeting the Measurement Challenge of the DigRF Digital Serial Interface

The DigRF v3 standard presents new challenges for mobile wireless development, integration and validation teams as the communications link between the BB-IC and RF-IC evolves from analog to digital. Spectrum analyzers used to evaluate analog interfaces are incapable of measuring the DigRF digital serial interface.

Agilent's N4850A acquisition probe and the N4860A stimulus probe operate in conjunction with Agilent 16800 and 16900 Series logic analyzers to provide the digital serial acquisition and stimulus capabilities required to independently evaluate an RF-IC or BB-IC with a DigRF v3 interface or integrate your mobile wireless designs.

The integration of DigRF v3 logic analysis tools with the Agilent RF portfolio provides the cross-domain solutions that will help you rapidly deploy your DigRF v3-based designs.

Specifications

N4850A DigRF v3 Digital Acquisition Probe

State Analysis for DigRF v3-Compliant Devices

- Maximum acquisition speed: 312 Mbps
- Voltage level support: 1.8 V LVDS, 1.2 V LVDS, SLVDS (200 mV min); See data sheet for SLVDS value updates
- SysClk speed support: 19.2 MHz, 26.0 MHz, 38.4 MHz
- Over air standard support: 2.5G and 3GPP (e.g. GSM, EDGE, CDMA, cdma2000, W-CDMA)

Monitor Device and System Operation

- Simultaneously acquires Tx/Rx bidirectional traffic
- Tracks changes across all speed modes – sleep, low power and high speed
- Displays data and control packets at the protocol level
- Triggers on protocol-specific packets, specific bits within a packet, and protocol violations

Additional Capabilities

- LEDs show DigRF v3 bus status and error conditions
- Identifies invalid sync words
- Supports up to 2048 bits for user-defined payload
- Extracts and transfers digital IQ for analysis with 89600 VSA software

Configuration Considerations

- Requires 16800 or 16900 Series logic analyzers with 68-channels or more
- E5381A flying lead set recommended for high impedance probing for signal integrity
- For stimulus, add an N4860A DigRF v3 stimulus probe and use a logic analyzer with a pattern generator
- Customize DigRF v3 protocol decoding with the B4641A Protocol Development Kit

N4860A DigRF v3 Digital Stimulus Probe

DigRF v3 Compliant Digital Stimulus

- Maximum stimulus speed: 312 Mbps
- Voltage level support: 1.8 V LVDS, 1.2 V LVDS, SLVDS
- SysClk speed support: 26.0 MHz (Contact Agilent for 19.2 MHz or 38.4 MHz support)
- Over air standard support: 2.5G and 3GPP (e.g. GSM, EDGE, CDMA, cdma2000, W-CDMA)

Stimulus Probe Operation

- Converts raw IQ and control information to DigRF v3-compliant data and control packets
 - Provides continuous DigRF v3 stimulus to replace a missing BB-IC or RF-IC
 - Enables modification of critical control settings while looping
- Methods for Creating Raw Digital IQ in Simple ASCII Format**
- Signal Studio www.agilent.com/find/signalstudio
 - Advance Design System (ADS) www.agilent.com/find/ads
 - Custom programming package
 - Captured logic analyzer trace converted to digital stimulus
- Configuration Considerations**
- Requires N4850A DigRF v3 acquisition probe
 - Requires 16800 or 16900 Series 68-channel logic analyzers (or more) with a pattern generator
 - Connects to target using SMA (m-m) connectors
 - Refer to data sheet for more information

Accessories

B4641A Protocol Development Kit – used to customize the DigRF v3 packet decoder for your unique extensions to the standard

Key Literature & Web Link

Agilent Solutions for the DigRF v3 Digital Serial Interface Used in Mobile Wireless Devices Brochure, p/n 5989-6224EN
N4850A DigRF v3 Acquisition Probe and N4860A DigRF v3 Stimulus Probe Data Sheet, p/n 5989-6058EN

www.agilent.com/find/DigRF
www.agilent.com/find/logic
www.agilent.com/find/DVSA
www.agilent.com/find/E4438C
www.agilent.com/find/signalstudio
www.agilent.com/find/scopes

Ordering Information

Order the following to configure a complete DigRF v3 digital acquisition and stimulus system. Refer to the data sheet for more detailed information

DigRF v3 Probes

N4850A DigRF v3 Acquisition Probe
N4860A DigRF v3 Stimulus Probe

Logic Analyzer with 68 Channels (or more) and a 48-channel Pattern Generator

16800 Series portables:

16822A (68-ch)
16823A (102-ch)

16900 Series modular system: A 16900 Series mainframe with at least one each of the following:

16900 Series Logic Analyzer Module
16720A Pattern Generator Module

Probe between the N4850A and the Device under Test

One of the following for each N4850A. The E5381A differential flying lead probe is recommended for the highest signal quality

E5381A Differential Flying Lead Probe
E5405A Differential Pro Series Soft Touch Probe
E5387A Differential Soft Touch Probe
E5379A Differential Samtec Probe

Samtec Probes between the N4850A and the Logic Analyzer

Order two Samtec probes that are compatible with your logic analyzer
E5385A Samtec Probe for Logic Analyzers with a 40-pin Cable Connection (16800 Series, 16910A, 16911A)
E5378A Samtec Probe for Logic Analyzers with a 90-pin Cable Connection (16950A/B, 16951B)

Order Separately to:

Analyze digital IQ:

89601A VSA Software

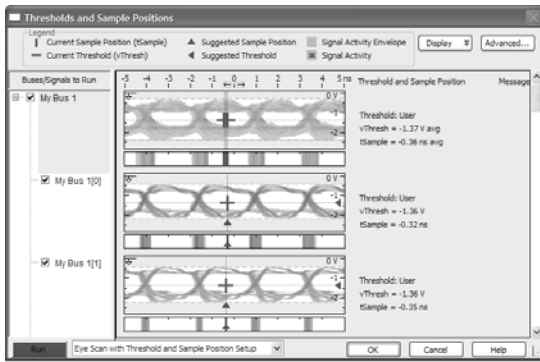
Create digital IQ data:

Signal Studio, Advanced Design System (ADS)

Customize the DigRF v3 packet decoder for your unique extensions to the standard:

B4641A Protocol Development Kit

B4601C
B4602A
B4606A
B4607A
B4608A
B4610A
B4630A
B4641A



Identify problem signals quickly by viewing eye diagrams across all buses and signals simultaneously.

Standard Displays Present Data in Familiar Formats for Faster Debug and Analysis

Automate Measurement Setup and Validate Signal Integrity

As timing and voltage margins continue to shrink, confidence in signal integrity becomes an increasingly vital requirement of the design verification process. With eye scan, you can have the same eye-diagram capability in a logic analyzer that you have in your scope, and it covers up to 510 channels at a time. Eye scan gives you a rapid, comprehensive overview across hundreds of signals simultaneously.

Debug Real-time Code at the Source Level

- Correlate the logic analyzer trace with the high-level source code that produced it
- Locate the cause of a problem by “stepping backward” from the point where you see a problem to its root cause
- Set up your next logic analyzer acquisition by simply pointing and clicking on a line of source code
- Determine the cause of data corruption by acquiring all activity relative to a variable

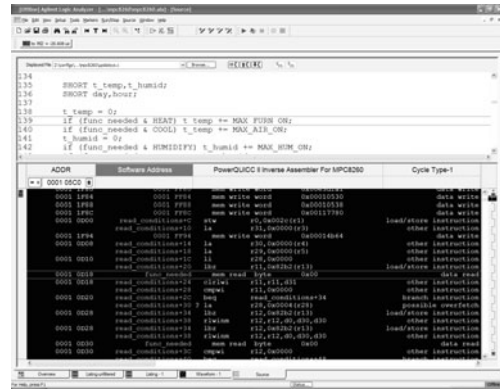
Trigger, Search, View and Analyze at the Packet Level

More designs are incorporating serial buses. With Agilent’s packet viewer you can trigger, search, view and analyze at the packet level. The display is customized for the protocol family being decoded by the packet decode tool. To optimize protocol viewing and analysis you can simultaneously view summarized and detailed packet information. Packet detail views include tabs for header, payload, and lane information.

Get Additional Insights Into Your Design with Multiple Views and Analysis Tools

As the complexity of digital systems increases, you need to analyze and view data in ways that were previously unavailable in a logic analyzer. The following analysis tools enable you to rapidly consolidate large amounts of data into displays that provide rapid insight into your system’s behavior:

- The B4601C Serial-to-parallel analysis package converts a serial data stream into parallel data words, performs clock recovery, processes frame and data portions separately, and removes stuffed bits from the data block
- Use the B4602A Signal Extractor Tool to extract I and Q data from simple serial protocols or re-multiplex high-speed digital data that has been de-multiplexed onto additional logic analyzer channels
- B4606A (Development and Runtime) and B4607A (Runtime) Advanced Customization Environment integrates Visual Basic for Applications (VBA) into the logic analyzer application for creating custom data analysis, data visualization, instrument control and measurement automation, and links to external PC applications



The split Source window displays the source code on top and the inverse-assembled trace below. The two traces are time-correlated and track as you scroll.

- B4608A ASCII Remote Programming Interface (RPI) allows you to remotely control the logic analyzer using ASCII commands
- B4610A Data Import Tool allows you to import external data into the logic analysis system and analyze it just like data acquired by the logic analyzer
- B4630A MATLAB Connectivity and Analysis package allows you to easily use your custom MATLAB routines in conjunction with data acquired from the logic analysis system
- B4641A Protocol Development Kit lets you create or modify existing protocol description files in order to decode, display and trigger on packet data. Useful for proprietary protocols or modifying existing industry standard solutions
- 89601 VSA software provides vector signal analysis and modulation analysis for digital baseband, IF and RF

Key Literature & Web Link

Application Support for Agilent Logic Analyzers, p/n 5966-4365E
www.agilent.com/find/pnbs

Ordering Information

Serial-to-parallel Analysis Package

- B4601C-010 Perpetual Node Locked License
- B4601C-020 Perpetual Floating (server) License

Signal Extractor

- B4602A-010 Perpetual Node Locked License
- B4602A-020 Perpetual Floating (server) License

Advanced Customization Environment

- B4606A-010 Development and Runtime Package, Perpetual Node Locked License
- B4606A-020 Development and Runtime Package, Perpetual Floating (server) License
- B4607A-010 Runtime Package, Perpetual Node Locked License
- B4607A-020 Runtime Package, Perpetual Floating (server) License

Remote Programming Interface (RPI) – Requires B4606A or B4607A

- B4608A-010 Perpetual Node Locked License
- B4608A-020 Perpetual Floating (server) License

Data Import Tool

- B4610A-010 Perpetual Node Locked License
- B4610A-020 Perpetual Floating (server) License

MATLAB Connectivity and Analysis Tool

- B4630A-010 Perpetual Node Locked License
- B4630A-020 Perpetual Floating (server) License

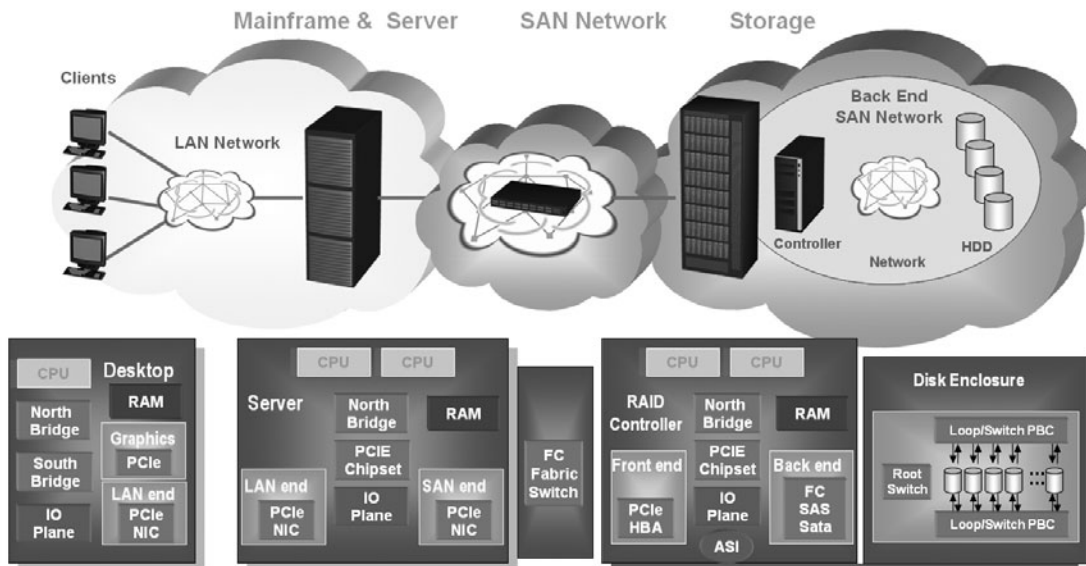
Protocol Development Kit

- B4641A-010 Perpetual Node Locked License
- B4641A-020 Perpetual Floating (server) License

Digital Vector Signal Analysis (DVSA)

- 89601A-200 Basic Vector Signal Analysis Software
- 89601A-300 Hardware Connectivity (includes link to Logic Analyzers)

- Enhanced system level view with time-correlated measurements on multiple protocol domains
- Accelerated test with a complete automation environment and scripting language
- Reduced capital expenditures with common hardware for protocol exercising, traffic generation and protocol analysis
- Investment protection with a flexible, scalable architecture



Reduce Computer and Storage Test Time by Combining Multi-Protocol Analysis and Traffic Generation in a Single Platform

Because Computer and Storage system's behavior is the result of tight interactions between multiple busses and protocols, identifying the root cause of defects or performance issues requires a real-time system level view on multiple protocol domains. In order to recreate the right test conditions, your test platform must also provide a deterministic traffic generation and device exercising capabilities.

Based on the modular, scalable, multi-user N2X chassis, the Agilent System Protocol Tester combines multi-protocol analysis, traffic generation, performance and conformance verification to debug, validate and optimize semiconductors, software and systems using high speed protocol standards.

The System Protocol Tester includes multiple test solutions for various applications:

- The **Protocol Analyzer** application helps you transparently record in real-time the protocol communication between two or more devices and easily visualize the trace information at the packet level with the right protocol decoding capabilities. Additional performance measurements and advanced triggering capabilities help quickly identify the root cause of your design problems.
- The **Exerciser and Traffic Generator** applications can stimulate your design with sophisticated traffic scenarios, and help accelerate test phases and improve product robustness. These applications also provide sophisticated device emulation capabilities to recreate complex or large scale test environments.
- The **Switch Testers** help characterize switches and networks performance under various traffic conditions, perform scalability testing and product robustness through device virtualization and negative testing
- The **Compliance Test Solutions** will perform tests in order to verify and ensure compliance with specifications defined by the standard bodies

Products & Services

PCI Express Exerciser and Analyzer (E2960A Series)

The E2960A test series, supporting the industry's move from parallel to serial I/O busses, provides the most complete and innovative array of test equipment for serial, PCI Express busses

PCI Express 2.0 Exerciser and Analyzer (E2960B Series)

The New E2960B test series is the industry's first complete solution for PCI Express 2.0 also supporting PCI Express 1.0. With superior midbus probing and the P2L Fibre Channel Test Solutions for Storage Area Networks (173x Series)

The 173x Protocol Analyzers, traffic generators and SAN tester help you design, debug, validate and characterize your next generation Fibre Channel equipment

E2920 Series Protocol Analyzer and Exerciser for PCI and PCI-X

Key Literature & Web Link

www.agilent.com/find/spt
www.agilent.com/find/fctester
www.agilent.com/find/pcie2

E2960A
E2960B

- **Reliable traffic capture and analysis using the x1 to x16 analyzer**
- **Full system viewing by using P2L gateway to connect the logic analyzer for cross correlation to memory and FSB (front side bus)**
- **Superior midbus probing with Agilent midbus 2.0: Probe the signal without changing it in any way**
- **Connect to your device with a passive or active slot interposer probe or a soft touch midbus probe**
- **Thorough link testing using the x1 to x16 LTSSM exerciser to generate training sequences at speed on all lanes**
- **Exercising the DUT – the fully featured x16 exerciser drives the DUT to the limits**
- **Two-in one: A single stimulus and response solution with the exerciser and analyzer**
- **Unique logic and protocol functionality in a single solution understand the data from layer 1 to the transaction domain**
- **Faster, easier and more effective PCI Express turn-on, debug, validation and compliance testing**
- **Combined traffic generation and protocol analysis dramatically increase the test coverage to reduce the risk of costly redesigns and recalls**
- **Universal hardware platform reduces expenditures for test equipment**
- **Multiprotocol test/cross bus analysis for semiconductors, cards and systems – simultaneously record PCI Express, Fibre Channel and Advanced Switching Interconnect traffic and transactions and time-correlate them within the same test setup and graphical user interface**
- **True bidirectional analyzer/exerciser for PCI Express x1, x4, x8 and x16**
- **Use the exerciser/protocol analyzer capabilities in combination to analyze root causes of problems with ease**
- **For efficient validation, capture traffic conditions, then drag and drop to reproduce system problems**
- **Multipoint testing allows you to stress all slots with the same load conditions and synchronize the tests**
- **External trigger in/out to synchronize with other devices**
- **Intuitive GUI lets you view and set up tests with ease**
- **LAN interface enables remote control and resource sharing**
- **USB adapter for ease of use**
- **Flexible and extendable platform protects your hardware investment**



Fastest Time to Insight – The E2960B and E2960A for PCI Express 1.0 and 2.0

E2960B Series for PCI Express 1.0 and 2.0

The E2960B Series for PCIe2™ (5 Gb/s) provides customers with the fastest time to insight by providing an integrated suite of analyzer and exerciser tools. With data capture users can trust and non-intrusive probing customers can spend their time analyzing their design and bringing their product to market quickly.

E2960A Series for PCI Express 1.0

The E2960A protocol analyzer and exerciser is ideal for efficient turn on, debug and validation of your PCI Express 1.0 (2.5 Gb/s) systems and designs and allows you to check them for compliance.

A Complete Solution for Every Stage of PCI Express Development

With the E2960B and E2960A Series for PCI Express 1.0 and 2.0, Agilent provides a complete, integrated and scalable tool chain that supports you in every stage of PCI Express device development. Both the E2960A and the E2960B feature a single solution for stimulus and response (exerciser) and traffic analysis (analyzer) enabling a fully integrated overview, a detailed observation of the DUT's behavior and a consistent look and feel across both exerciser and analyzer.

To thoroughly test your PCI Express systems and devices, you may need to create system conditions that are difficult to reproduce with existing PCI Express equipment. The E2960A/B protocol exerciser and analyzer lets you quickly and easily simulate traffic or capture traffic conditions and recreate them. The protocol exerciser lets you stress all data paths in a system and test corner cases and behavior by inserting errors and protocol violations on each layer (physical, data link and transactional).

E2960A/B Protocol Analyzer for PCI Express Gives you Fast Access to Reliable and Understandable Data

The E2960A/B protocol analyzer for PCI Express captures the traffic or transactions on a PCI Express link and allows you to analyze it and troubleshoot problems to find the root cause. The protocol analyzer provides non-intrusive monitoring of traffic between two PCI Express devices (either a system talking to an add-in card or the exerciser talking to an add-in card or system). With its capabilities in analyzing generated PCI Express traffic, the analyzer is perfectly suited for turn-on and debug of PCI Express systems and designs. It captures and analyzes packets from the physical up to the transaction layer as well as training sequences and ordered sets.

There are analyzer solutions for all link width (x1 up to x16) and speed grades (2.5 Gb/S and 5 Gb/S available). Advanced triggering capabilities that reduce the time needed to detect even difficult to find errors are available on all solutions.

The E2960B features “per lane LEDs” that give an instantaneous feedback on the link, lane and speed status (manual and automatic speed setting), both on the I/O module as well as the GUI. The “per lane display” shows data even prior to channel bonding completion including 8b, 10b or K/D symbols. 2 “Trigger-down-the-lane” patterns allow triggering on ordered sets on selected lanes.

An easy-to-use GUI offers graphical trigger setup, search and filter capabilities to help you intuitively interpret PCI Express transactions. The context sensitive and easy flow technologies allow to display data easily understandable but also very condensed.

E2960A/B Probing Options

The E2960A/B analyzer offers various different probing options to support PCI Express 1.0 and 2.0 probing. Beside others, the probing options comprise interposer probing, midbus probing, express card and flying leads.

The Agilent midbus 2.0 series of probes using soft touch technology gives insight to the system without influencing it. It is a non-intrusive and passive probing option, providing extremely low capacitive loading (less than 150 fF). The Agilent Midbus 2.0 probing solution is available to support various layout requirements and needs.

P2L for Full System Viewing

The P2L gateway enables connecting to the Agilent Logic Analyzer to do time correlated cross bus measurements and cross triggering. Both Logic Analyzer and Protocol Analyzer instruments can be operated from a single PC.

E2960A/B Protocol Exerciser for PCI Express lets you Test and Validate your System's Performance under Varied Conditions

With its fully adjustable parameters, the E2960A/B protocol exerciser lets you emulate any PCI Express design. Furthermore it is capable to generate and respond to any PCI Express packet or sequences of packets. It is an intelligent I/O communication tool that can react as a PCI Express end node or root complex. The E2960A/B exerciser's functionality extends far beyond the capabilities of a simple packet generator. It is tailored to validate corner cases and emulate stress conditions for components on system boards and add-in cards. The protocol exerciser is the ideal tool to test and validate x1 up to x16 PCI Express designs.

The E2960A/B exerciser lets you stress all data paths in your system so you can force it to fail. You can also insert errors and test the behavior of designs in response to these errors to enable worst-case-scenario testing.

Using the x1 through x16 LTSSM exerciser (Link Training and Status State Machine) training sequences and ordered sets can be generated across all the lane widths, enabling effective testing of the link negotiation and supporting dynamic lane width changes.

Using the passive backplane, you can verify your device in a controlled environment that gives you a quite PCI Express bus independent of a system. The passive backplane features 3 independent busses, all prepared for traffic up to x16 and includes reset, standby power, SSC etc.

N2X Platform Continuity

The E2960A/B protocol analyzer and exerciser for PCI Express are based on the modular system tester platform with Agilent's N2X technology. The universal and upgradeable platform offers multi-protocol and time correlated test/cross bus analysis support for ASI, PCI Express and Fibre Channel applications and protects capital investment. Components from one generation can be reused in the next generation.

The complete software including the GUI is also the same for both series of products, so customers can protect their investment and leverage their existing know-how to start PCIe 2.0 testing immediately.

The APIs are backward compatible so that previously developed scripts can be reused.

Powerful Triggering, Easy Setup

The protocol analyzer's sophisticated trigger capabilities are based on a trigger sequencer. It offers an easy-to-use set up and graphical representation of the trigger sequence. Examples and listed predefined conditions reduce time-consuming trigger setups. You can define up to 8 states, 8 patterns and 2 counters with various actions store, increment counter, trigger out and so on.

Specifications

Specification for E2960B Protocol Analyzer

Display Features

- Highly configurable GUI, based on a configurable tabular view
- Color Customization
- Condensed data view using context sensitive columns
- "Ping-Pong" view of upstream/downstream data with Easy Flow
- Easy navigation within captured trace
- Traffic overview (post capture)
- Per lane display to display data of individual lanes
- Record decode and single line view
- Expand and collapse packets in order to obtain more information
- Packets with errors are highlighted
- Colour-coded transaction types allow easy recognition of various types of traffic
- Multiple markers with comment functionality
- Display with time-stamps

Trigger Features

- Graphical trigger setup
- Trigger sequencer with up to:
 - 8 states
 - 2 counters/timers
 - 4 pattern terms
 - External trigger in and out
 - Protocol error trigger (disparity error and invalid 10b symbols)
 - Multi-way branching
- Filtering (real time):
 - Idles
 - On a per-packet basis controlled by the trigger sequencer
 - Filter conditions can be defined individually for each trigger sequencer state
 - Storage qualification
 - Trigger on payload (first 1 or 2 dwords)

Traffic Capture Features

- Supports capturing in x1, x2, x4, x8, x16 link width with 2.5 GT/s and 5 GT/s
- Non-intrusive traffic capturing
- Captures training sequences, ordered sets, data-link-layer packets and transaction-layer packets in both directions simultaneously
- Supports data rates 2.5 GT/s and 5 GT/s (± 300 ppm)
- Error detection
- Disparity errors and invalid 10b symbols in hardware
- LCRC, symbol, disparity, EDB, framing, idle data Malformed packet check (CRC error, invalid field contents, length mismatch) in software

Other Features

- Analyzer to exerciser traffic record and replay
- Example traces + triggers settings + programming examples
- Timestamps with 8 ns resolution (absolute and relative)
- Automatic lane polarity detection
- 1 GB trace memory
- Latency measurements (using markers)
- External trigger in/out

Exerciser Physical Layer

- Fully automated symbol encoding/decoding, and generation and validation of packet framing; ability to report framing errors to user
- Scrambling can be turned on or off by user
- Configurable, automatic link initialization and training:
 - Automatic Lane Polarity Detection (RX), separate for each lane
 - Programmable Lane Polarity Inversion (TX), separate for each lane
 - Automatic link width negotiation; link widths x1, x4 supported; user can configure which widths will be negotiated during link training
 - Programmable Lane Reversal (TX, RX automatic)
 - Programmable Lane Skew: (± 7 symbols, resolution: 1 symbol time)
- Link Training and Status State Machine: Full support for states Detect, Polling, Configuration, Recovery, L1, L0s, L0
- Programmable skip rate and number of SKPs per skip OS

E2960A

E2960B

Data Link Layer

- Fully implemented data link control and management state machine
- Automatic flow control initialization; programmable credits and flow control update rate
- Automated generation of data link layer packets (DLLPs): ACK/NAK, Init/Update-FC
- Automatic generation and checking of LCRC and sequence numbers; allows the insertion of incorrect LCRCs into TLPs for testing purposes; automatic retry management

Transaction Layer

- User software can define arbitrary sequences of transactions
- “Send single packet” for simple packet transmission one memory for block transactions per virtual channel
 - Full support for two virtual channels (VCs)
 - Conditional start on RX pattern matcher, external trigger in and completion status
 - Generation and receiving of packets at maximum band width (stress testing) up link width x8 at 5 GT/s Infinite loop
- 1 completer queue defines the way completion packets are sent out (e.g., lengths, errors inserted, partitioning, etc)
 - Completions can be split into individual packets
- Up to 32 outstanding requests can be “pending” (256 in extended mode) – request without completion
- Decoders (6 BARS + Expansion ROM decoder)
- Payload generation and reception from/into data memory

Error Generation and Analysis Features

Error insertion capabilities on the physical layer, data link layer and transaction layer

Physical Layer

- Transmitter polarity inversion
- Transmitter lane reversal
- Deterministic lane skew up to 7 symbols
- Link width and lane sequence negotiation emulating an x1, x4 device
- Sending packet with incorrect “running disparity”
- TX framing errors on TLPs

Data Link Layer

- Sending packets with incorrect LCRC
- Programmatically answers NAK instead of ACK, for retry buffer test
- Wrong sequence numbers

Transaction Layer

- Arbitrary header field contents
- Sending “nullified TLPs”
- Sending “poisoned TLPs”
- Advertised packet length (in TLP header) different from actual packet length (by one DWord)
- The transmitter ignores flow control credits
- Completion loss/delay

Configuration Space Features

- Can emulate the configuration of different types of PCI Express devices
- Supports up to 6 base address registers and expansion ROM decoder
- Full support for PCI Header type 0 configuration space
- Supported Capability Structures:
 - PCI power management capability structure
 - MSI capability structure
 - PCI Express capability structure
- Virtual Channel capability structure

LTSSM Exerciser

Display Features

- Explorer like tree structure to select test
- Display of test log in GUI
- Feedback of state transitions performed
- Timestamp in [ns] for all states
- Link status indications
- Link width x1, x4, x8, x16

Debug Support Features

- External trigger on exit from L0
- Log file output of LTSSM-Exerciser state transitions and Timestamps
- Automatic flow control initialization with infinite credits

Supported States

- Detect
- Polling
- Configuration
- L0
- Recovery

Error Injection

- Pre-defined test cases for recovery state

Specification for E2960A

Protocol Exerciser

- Generates and responds to PCI Express packets and packet sequences
- GUI, DCOM application programming interface, TCL interfaces and in-system port control
- Error insertion lets you test corner cases and failure behavior
- Simulate or emulate an PCI Express end node

Perform Realistic Tests with Device Emulation

- Simulate various test scenarios by setting exerciser parameters the way you want
- Minimize the number of real devices needed to create a large-scale test environment
- 2 MB data memory allows you to emulate PCI Express end nodes
- Easily record packets from the protocol analyzer and replay with the exerciser as many times as you want. Use drag and drop or copy and paste functionality or export files from the protocol analyzer
- Use external trigger in/out for cross triggering, event triggering and triggering another device/instrument for more thorough troubleshooting
- Real-time data compare feature allows you to check the integrity of your data to give you more confidence in your results

Increase Test Coverage with Configurable Traffic Generation

- Transmit and receive PCI Express traffic at full bandwidth of x1, x2, x4 and x8 link widths with 2.5 Gbps
- Customize the traffic you send: Generate requests with parameters and behaviors you define
- Use a wide range of real-world traffic conditions
- Validate the boundary conditions of your system
- Generate any combination of PCI Express packets for multiple ports and correlate the test results across time for comprehensive system testing
- Stress your system to the max: test your system under worst-case conditions and see how devices act during error conditions
- Algorithmic data generation/checking feature allows you to compare-incoming packet payload against algorithmically generated reference data
- Fully configurable configuration space, including PCI Express extended capabilities

Real-time Statistics Help you See Immediate Changes in your System's Performance

- Real-time performance counters

Customize your Measurements with Test Automation and Scripting Capabilities

- Control software via the easy-to-use graphical user interface, programmatically through DCOM or TCL interfaces and via an in-system port (via system under test)
- Create and automate your test procedure to eliminate tedious manual testing
- Repeat tests for subsequent product builds
- Protocol checker automatically checks 23 protocol rules based on the PCI Express specification

Protocol Analyzer

- Non-intrusive traffic capturing for PCI Express x1, x2, x4 and x8
- Root cause and performance analysis
- GUI with graphical trigger setup, search and filter capabilities
- Sophisticated trigger capability with patented dynamic triggering and storage qualifications
- Captures training sequences, ordered sets, data-link-layer packets and transaction-layer packets in both directions simultaneously
- Trigger sequencer with up to:
 - 8 states
 - 2 counters/timers
 - 8 pattern terms
 - External trigger in and out
 - Protocol error trigger
- Supports data rates 1.25 – 2.5 GT/s
- 1 GB trace memory
- Traffic overview
- Packet decode view
- Automated Error detection functionality of disparity errors, invalid 10 b symbols in hardware, LCRC, EDB, framing, idle data and Malformed packet check (CRC error, invalid field contents, length mismatch)
- Hex display
- Separate, cross-correlated packet view
- Customizable view of captured transaction
- Tabular view with configurable columns
- Color-coded transaction types allow easy recognition of various types of traffic
- Expand and collapse packets in order to obtain more information
- Context-sensitive field decoding
- Tool tips for each field provide more information as needed
- Interleaved display, including time-stamps
- Performance counters
- Different connections to the device under test with active, passive and midbus probing
- Traffic activity, port link status, and trace content are simultaneously displayed
- Avoid constant scrolling with the tabular display that maximizes information density on the screen
- See packet details by zooming on multiple lines
- Easily retrieve information with embedded markers
- Quickly find problems with automatic error detection highlighted
- Transaction captured from multiple ports are displayed with common time stamps and common markers
- Multiple analyzers can share events for sophisticated cross triggering
- TCL script capabilities for test automation and customized test development

Key Literature & Web Link

www.agilent.com/find/pcie2
www.agilent.com/find/E2960_series
www.agilent.com/find/PCI_Express

Related Literature Publication Number

The Agilent Test Portfolio for PCI Express 2.0, Brochure 5989-5594EN
 Agilent E2960B Series for PCI Express 2.0, Brochure 5989-5610N
 Agilent E2960B Series for PCI Express 2.0, Data Sheet 5989-5660EN
 Agilent Technologies, System Protocol Tester, Brochure 5989-2526EN
 Agilent Technologies, PCI Express Tools, From the Physical Layer to a Fully Operating System, Brochure 5988-7780EN
 E2960 Protocol Analyzer and Exerciser for PCI Express, Data Sheet 5988-8679EN
 Agilent Technologies, Protocol Test Card for PCI Express, Photocard 5988-9502EN
 Agilent Technologies, E2969A Protocol Test Card for PCI Express, Data Sheet 5989-0878EN

Ordering Information

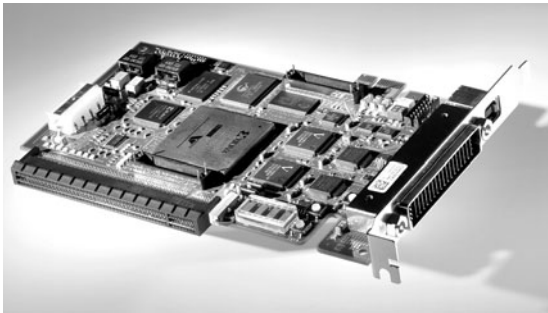
The E2960A and E2960B are available in a variety of setups.

For more details information, visit the product website at www.agilent.com/pcie2

E2960A
E2960B

E2969A

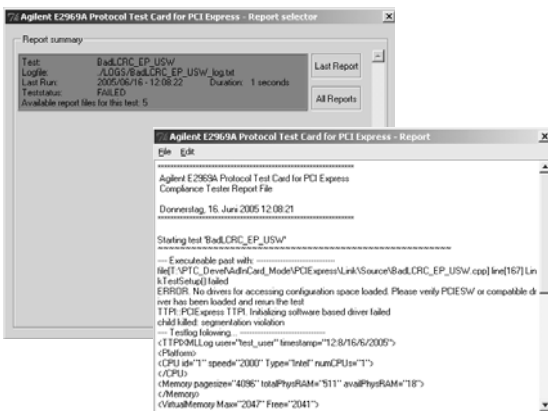
- Fast and easy compliance testing of PCI Express designs
- Cost-effective push-button solution
- Easy-to-use
- Pre-programmed compliance tests
- Sophisticated trigger capability and storage qualifications
- Support compliance of an PCI Express add-in card and system



E2969A Protocol Test Card for PCI Express compliance testing.



Graphical User Interface with test selection.



Report Summary Window

The E2969A is a protocol test card for PCI Express, which performs tests in order to verify and ensure compliance with PCI Express specifications as defined by the PCI SIG. The protocol test card is a collaborative development between Agilent and Intel® and will coincide with the Intel product development solutions for PCI Express. In addition the card also guarantees the interoperability of the DUT with other PCI Express devices. It is developed primarily for use by R&D engineers who wish to validate the functional compliance of their PCI Express based designs, including chips, add-in cards or systems. The card is simply plugged into the DUT and is ready for use as soon as the software has been installed. The card supports following operating modes:

- Add-in-card Test Mode
- Known Endpoint Test Mode (KEP)
- Topology/BIOS Simulation Test Mode

The three test modes provide pre-programmed tests, which are executed by means of a Graphical User Interface (GUI). The modes can be selected either via the software (in the GUI) or by setting a dipswitch on the card.

The Graphical User Interface allows the user to select tests and execute them. There are two main windows available in the GUI. All tests in the corresponding mode are listed with name and description relative to the PCI Express Specification. In the description field, tool tips provide a detailed description of each test. Individual or groups of tests can be selected and are executed using the run button. After running the tests, the GUI shows the status of each test by indicating green for passed and red for failed. For more details on the tests, the report window should be selected.

Add-In Card Test Mode

In this mode the PTC is inserted between the system and a PCI Express add-in card to be tested. The Protocol Test Card now acts as switch device between the system and the PCI Express add-in card (the Device Under Test, DUT). The DUT is inserted into the PCI Express slot on top of the Protocol Test Card. The top connector is capable of accepting up to x16 PCI Express cards; however, these will be tested in PCI Express x1 mode. The tests in this mode are used to check the correct behavior and functional compliance of the PCI Express add-in card (DUT). The test software communicates commands to the PTC via PCI Express and performs various tests on the DUT. In this mode it is necessary to power the PTC using the external power connector. A standard AT/ATX Power Connector can be used for this purpose.

The GUI of the PTC monitors the behavior of the add-in card, its device drivers and OS in response to a range of inserted errors.

Known Endpoint Test Mode

In this mode the Protocol Test Card behaves like a known endpoint device. This mode is used for testing chipsets. No other card can be inserted into the Protocol Test Card in this mode. The Protocol Test Card itself acts as a known endpoint. The tests in this mode monitor the behavior of the platform.

Topology/BIOS Simulation Test Mode

This test mode is where the Protocol Test Card appears as a complex PCI Express topology. It aids in verifying the PCI Express compliance of the BIOS, and that it is able to detect and initialize a complex PCI Express topology correctly.

Specifications

- Works in PCI Express x1 mode
- Allows x1, x4, x8 & x16 cards to be plugged in
- Graphical user interface
- Automated pre-canned compliance tests for the Transaction Layer and the Data Link Layer
- Tests power management and configuration space
- Carefully monitors the behavior of the DUT in response to certain error conditions
- Connection to protocol analyzer for root cause analysis of failed compliance tests
- Known endpoint and switch functionality
- Field upgradeable FPGA-based card
- USB 2.0 interface for programming and topology simulation mode
- Can act either as a PCI Express standalone add-in card
- Card controlled via PCI Express or via an external host

Accessories

It is recommended to add the E2960A-A01 Protocol Analyzer for PCI Express x1 to the E2969A test setup so it is possible to debug and trace problems to their root cause. Use the preprogrammed tests to speed your compliance testing. Connect the E2969A PTC to the protocol analyzer and troubleshoot potential out-of-compliance behavior.

Key Literature & Web Link

www.agilent.com/find/E2969_PTC
www.agilent.com/find/E2960_series
www.agilent.com/find/PCI_Express

Related Literature Publication Number

- Agilent Technologies, System Protocol Tester , Brochure 5989-2526EN
- PCI Express Tools, From the Physical Layer to a Fully Operating System, Brochure 5988-7780EN
- Agilent Technologies, E2960 Protocol Analyzer and Exerciser for PCI Express, Data Sheet 5988-8679EN
- Agilent Technologies Protocol Test Card for PCI Express, Photocard 5988-9502EN
- Agilent Technologies, E2969A Protocol Test Card for PCI Express, Data Sheet 5989-0878EN

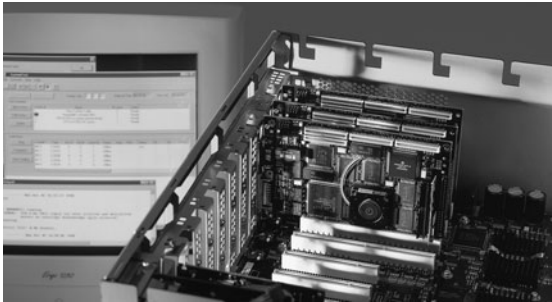
Ordering Information

Go to the following webpage and request an instant quote for your country via the Agilent online Quick Quote program.

www.agilent.com/find/E2969_PTC

E2928A
E2929B
E2930B
E2940A

- Support for PCI, PCI-X 1.0/2.0 and CompactPCI
- Graphical User Interface
- Programming interface (CAPI and TCL)
- Analyzer with 2 M state trace memory
- Exerciser with split transactions and 1 MB data memory and real-time data generator
- Automated real time Protocol Checker with up to 53 rules
- Automated test suite with compliance tests
- Performance Analysis real time
- Patented protocol permutator and randomizer
- Fully PCI-X compliant
- USB 2.0, external 4 MB fast host interface
- Controllable in-system through PCI-X



PCI Server during system validation with the Agilent E2928A

PCI/PCI-X Series Exerciser & Analyzer

The Agilent E2920 PCI/PCI-X Series of Verification Tools is a family of test tools designed to provide an early and extensive insight into PCI/PCI-X-based designs, revealing and solving design problems sooner throughout the entire development process, from initial bring-up of devices and systems, through to system validation.

The tools supplied with the E2920 PCI/PCI-X Series not only help you get your new designs to market faster, but also give you the confidence of knowing your product will perform in any conceivable situation.

For more information visit our web site:
www.agilent.com/find/pci_overview

Evaluate: Getting Your Design Off to a Good Start

In the early stages of your PCI/PCI-X based prototype evaluation, you need to analyze the behavior of your system, device or firmware and detect the cause of any errors or problems as early as possible during the bring-up and debugging. The PCI/PCI-X Analyzer features a PCI/PCI-X state logic analyzer, real-time protocol and timing checkers, real-time performance measures and a PCI/PCI-X optimized trigger, giving you a fast overview of your system status.

PCI/PCI-X bus traffic from the state waveform level up to data transfer level can be captured and analyzed, allowing the observation of traffic at a level meaningful to the problem. The identification and triggering of protocol violations is possible at any time.

For more information visit our web site:
www.agilent.com/find/pci_evaluate

Optimize: Overcoming the First Hurdles

Optimizing a PCI or PCI-X design means applying your expertise to the analysis of traffic and of bus performance and then applying what you find to help improve your devices. The PCI/PCI-X Performance Optimizer is a powerful tool, which provides you with an in-depth real-time and post processing performance analysis, giving hints for performance optimization. The PCI/PCI-X Exerciser plays an active role in the analysis of complex PCI/PCI-X scenarios by letting you set up worst case traffic patterns quickly and allowing errors to be easily reproduced for deeper investigation. Identifying bottlenecks and true performance potential helps you optimize your design.

For more information visit our web site:
www.agilent.com/find/pci_optimize

Validate: Ensuring Reliability in the Long Run

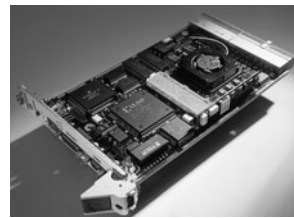
Validating your PCI/PCI-X device means ensuring its reliability in the long run. The E2920 PCI/PCI-X Series use the PCI/PCI-X bus as the "standard" interface to validate a system. Variable levels of background traffic can be generated and typical peripheral traffic patterns emulated to stress arbitration, memory controller, bridges and system interrupts. The System Validation Package (Opt 310) provides a set of tests for testing particular sub-systems. The C-Application Programming Interface (C-API) available with the Protocol Permutator and Randomizer (PPR)(Opt 320) enables full range testing. Automatic protocol permutations within user-defined constraints, enable optimum test coverage of PCI/PCI-X behavior of a device or system, in the minimum amount of time.

For more information visit our web site:
www.agilent.com/find/pci_validate

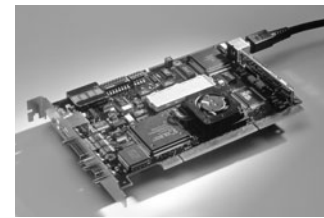
System Description

The PCI/PCI-X Exerciser and Analyzer is delivered as a single, short card, which requires plugging into the system that needs to be tested. Plugging other PCI/PCI-X devices into the system-under-test enables these devices to also be tested.

The E2920 PCI/PCI-X Exerciser and Analyzer can either be externally controlled by a RS-232, a 4 MB fast host interface, USB (E2929B), USB 2.0 (E2930B), or through the system-under-test via PCI/PCI-X.



Compact PCI Exerciser/Analyzer Card



PCI-X Exerciser/Analyzer Card

Key Literature

E2930B Technical Specifications, p/n 5989-0387EN
E2920 Verification Tools, PCI/PCI-X Series, Color Brochure, p/n 5968-9694E
E2928A, Technical Specifications, p/n 5968-3506E
E2922B, Technical Specifications, p/n 5968-9577E
E2929B, Technical Specifications, p/n 5968-8984E
E2940A, Technical Specifications, p/n 5968-1915E
System Validation Package, Technical Overview, p/n 5968-3500E

For customer reference stories/application notes and latest ordering information, please visit our web site: www.agilent.com/find/pci_overview

Software/Graphical User Interfaces

The **PCI/PCI-X Analyzer Graphical User Interface** is a comprehensive Windows graphical user interface for the PCI/PCI-X exerciser and analyzer's on-board logic analyzer. It allows the analysis of bus traffic quickly and easily:

- Easy setup of trigger sequences and storage qualification for the on-board PCI/PCI-X state logic analyzer
- Real-time PCI/PCI-X protocol checker
- State Waveform Lister displays waveform trace of all PCI/PCI-X signals, sideband I/O and internal bus state signals
- Bus Cycle Lister disassembles bus traffic at state level, with comprehensive error reporting including cross references to PCI/PCI-X specification
- Bus Transaction Lister summarizes bus transfer at address and data level

The **PCI/PCI-X Exerciser Graphical User Interface** (comes with #300) is a comprehensive Windows graphical user interface, which controls the PCI/PCI-X exerciser and analyzer's programmable PCI/PCI-X master and target:

- Configuration Space Editor to set up the configuration space
- Master Transaction Editor to set up master transactions and protocol behavior and requester/completer for PCI-X
- Target Attribute Editor to set up protocol behavior for the target
- Data Memory Editor to view/modify the on-board memory content

PCI/PCI-X Exerciser and Analyzer Comparison Table

	E2940A	E2928A	E2929B	E2930B
Data-Path Width	32/64 bit	32/64 bit	32/64 bit	32/64 bit
Addressing	32/64 bit DAC	32 bit/64 bit DAC	32 bit/64 bit DAC	32 bit/64 bit DAC
PCI Clock Range	0...66 MHz Analyzer 0...33 MHz Exerciser	0...66 MHz	0...133 MHz	0...133 MHz (200 MT/S)
State PCI Logic Analyzer Trace Memory	64 K on-board/ 4 M (E2995A)	64 K on board/ 4 M (E2995A)	#100, 2 M on board	4 M on board
Mechanical	Compact PCI card	PCI short card	PCI-X short card	PCI-X short card
Fast Back to Back (master)	Yes	No	N/A	N/A
Target Decode Speed	Fast/Medium/Slow	Fast ¹ /Medium/Slow	Fast/Medium/Slow	Fast/Medium/Slow
LOCK Control	Lock/Hide/Unlock	No lock control	No lock control	No lock control
Programmable Clock Delay Between Transactions	0 to 2,000,000	0 to 2,000,000	1 to 65,536	1 to 65,536
Real-Time Counter Size	64 bit	64 bit	64 bit	64 bit
Signal Levels	3.3/5 V	3.3/5 V	3.3 V	3.3/1.5 V
Temperature Range	–40°C to 70°C	–40°C to 70°C	–40°C to 70°C	0°C to 50°C
Trigger I/O	12	12	4	4
Data Memory	512 KB	512 KB	1 MB	4 MB
Real-Time Checked Protocol Rules	53	53	53	over 64
Control Interfaces	RS 232, fast host interface, PCI	RS 232, fast host interface, PCI	RS 232, fast host interface, USB, PCI-X	USB 2.0
PCI Compatibility	PCI 2.1	PCI 2.1	PCI-X 1.0	PCI-X 2.0

¹ Fast, decode speed up to 66 MHz.

The PCI/PCI-X Performance Optimizer (comes with #200) is a comprehensive Windows graphical user interface using the exerciser and analyzer capabilities to help engineers optimize performance (not available for the E2930B). It features:

- Performance analysis with real-time counters and in-depth post processing
- Hierarchical data representation for fast problem detection and in-depth root cause analysis with report generation
- Numerable ready-to-go tests: data transfer rate, data efficiency, bus usage, retry rate

The System Validation Package (comes with #310), which is a ready-to-use software package running on Windows to perform system stress test during system validation. It automatically sets-up tests to stress the computers data paths from:

- CPU and Exerciser to system memory
- Exerciser to system memory
- CPU to Exerciser memory space
- CPU to Exerciser I/O space
- Peer to peer traffic
- Master to target traffic

C-API and PCI/PCI-X Protocol Permutator & Randomizer Library (comes with #320), which provides automatic PCI/PCI-X protocol permutations within user-programmed constraints. It features:

- Reduced and predictable test time, as use of the system CPU is not required
- PCI/PCI-X master and target support
- Comprehensive reports of performed protocol variations

The following accessories are available for the E2920 Verification Tools, PCI/PCI-X Series:

Agilent Products	E2940A	E2928A	E2929B	E2930B
E2991A External Power Supply		✓	✓	✓
E2993A External Agilent Logic Analyzer Adapter		✓		
FS2104 Future Plus Logic Analyzer Adapter			✓	
E2994A General Purpose Logic Analyzer Adapter		✓		
E2995A 155 x 4 M Trace Memory		✓		
E2996A 155 x 4 M Trace Memory	✓			
System Test Library	✓	✓	✓	

In addition, the E2922B PCI-X Master Target Card is available for larger labs with multiple test benches.

E2928A
E2929B
E2930B
E2940A

- **1 Gb/s, 2 Gb/s, 4 Gb/s and 8 Gb/s Fibre Channel** – test current and next generation Fibre Channel systems
- **One system, Multiple Applications** – same hardware can be used for Protocol Analysis, Traffic Generation, or Device Emulation (SAN Testing). This reduces your capital expenditures and increase productivity
- **Full Featured, Intuitive Operation** – focus on solving your problems, not on mastering your debug tools. Set up measurements easily and navigate through your data quickly with the intuitive user interfaces
- **Reproduce Complex Traffic Conditions** – easily reproduce problems with sophisticated traffic generation capabilities
- **Modularity and Expandability** – purchase the capability you need now, then expand as your needs evolve. The same platform can be used from the design phase to system deployment, installation and maintenance. A small, lightweight chassis is available for portable or desktop testing. Users can easily daisy chain up to three racks of high-density Chassis for large test configurations
- **Multi-User system and Remote Connection** – increase your productivity and maximize your test system usage by local or widely-distributed teams with offline analysis, remote control and programmability features



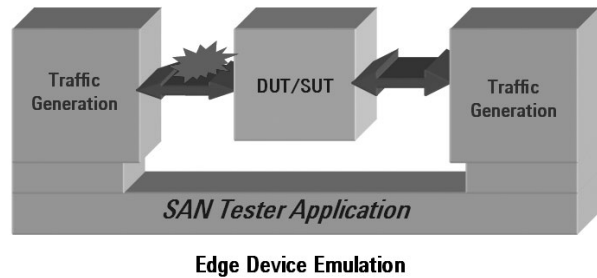
The Agilent 173x Series Fibre Channel Test Solution provides an efficient way for semiconductor manufacturers, network equipment manufacturers and storage solution integrators to introduce high-quality products to the market. The 173x Series accelerates the configuration, validation, characterization and debugging of Fibre Channel equipment, while significantly reducing the number of test devices needed.

A traditional Fibre Channel test environment includes active test tools that generate traffic conditions needed to test all of the fabric and equipment capabilities, together with passive protocol analyzers to transparently monitor protocol communications within the network. There are significant challenges related to the integration of heterogeneous test tools and various APIs in a common test environment. The Agilent 173x Series, with its modular and scalable architecture combines Fibre Channel Protocol Analysis, Traffic Generation and Fabric Performance Measurement in a common versatile, multi-user N2X chassis, helping you gain instant insights into your system with multiple applications and analysis tools.

Typical Customers

Typical customers for the 173x Series fibre channel test system include :

- Fibre Channel switch manufactures
- Storage extension device manufactures
- DWDM equipment providers
- Storage IC providers
- Storage equipment manufactures
- Server manufactures
- Storage integrators
- Service providers deploying storage services



SAN Tester Software Application (Active Test)

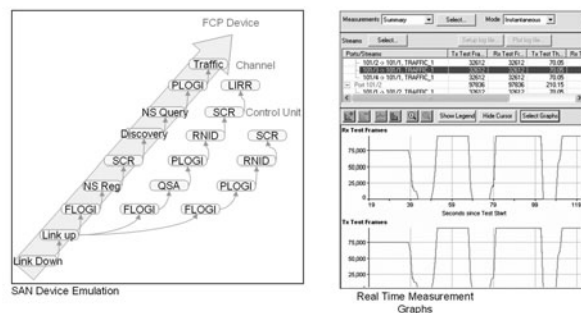
The SAN tester software is an Active Test application that helps you stimulate your Fibre Channel design with configurable traffic. The SAN Tester application will also characterize the performance and scalability of your Fibre Channel design using real-time measurements including Throughput, Latency, Lost Frames and Errors. The SAN Tester application can be used to test Fibre Channel Semiconductors, Switches, Directors & Fabrics.

Using the SAN Tester software application, each test port can be configured as one or multiple Fibre Channel devices sending and receiving wire speed traffic to other devices. Port to port, partial mesh and full mesh configurations can be created, testing your devices with realistic or extreme traffic conditions.

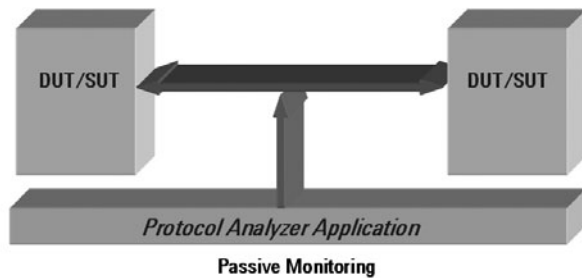
The SAN Tester software application provides extensive parametric control of wire speed Fibre Channel traffic generation and real time continuous monitoring of performance, robustness, reliability of SAN systems. Thanks to the scalability of the Agilent platform, it can test individual devices to large-scale SAN infrastructures.

Features of the SAN Tester software application includes:

- **Flexible port emulation** – test ports can be configured in N_port or L_port mode
- **Configurable device emulation** – test ports or emulated devices can be configured to mimic different HBAs and different initialization process
- **Multi-protocol support** – test ports can be configured as Fibre Channel Protocol (FCP) or FICON devices
- **Variable Traffic Modes** – varies traffic modes exist to better simulate real network conditions. Traffic load can also be modified in real time to identify the knee of the system's performance curve
- **Real time measurement** – each test port acquires continuous real-time traffic statistics for better insight into how your system is performing. Statistics reported include throughput, latency, lost frames, CRC errors and sequence errors



Protocol Analyzer Software Application



The Protocol Analysis software application helps you passively monitor the communication between 2 or more Fibre Channel devices. With effective presentation, the protocol analysis application helps you quickly understand what is being communicated and the exact timing of the communication between the multiple devices on the network.

Using the Protocol Analysis software, each analyzer is able to capture relevant information by combining a deep trace and an intuitive dual channel, state based triggering and filtering engine. The application also contains Agilent unique features such as Easy Flow visualization, comprehensive decoding, extensive pattern libraries, drag and drop functionality, helping you quickly find the root cause of problems.

Features of the Protocol Analysis Application include:

- Dual Channel, Multi-state triggering engine – ensures the problem event is actually captured
- Easy Flow visualization – graphically depicts the precise time and flow of information through multiple analyzers
- Context Sensitive Columns – displays only relevant protocol field to maximize understanding the protocol interaction
- Multi-protocol platform – provides cross correlation to other protocols in the same platform



SAN Director Tester

The Agilent Technologies 1733L SAN director tester simplifies the testing of director-class switches in QA and manufacturing environments. Now you can easily generate I/O traffic to test the performance and availability of your director switches while lowering your overall cost of test.

Existing test methods of using a large number of PC controllers, or a “wall of PCs”, to generate I/O traffic to stress the director switch has a number of limitations, including lack of centralized control, unable to scale and cost considerations in terms of power and space consumption.

The 1733L SAN Director Tester is small and compact. With realistic Fibre channel 4 Gb/s traffic generation and real time measurements on all 128 ports, and by providing a centralized multi-port control panel the 1733L SAN director tester simplifies test setup, execution and analysis, resulting in faster test completion.

Specifications

Technical Specifications for the 173x Series

Physical Interface

Number of Ports

- Up to 4 SAN Tester ports per module
- Up to 2 pairs of Protocol Analyzers per module (4 ports)

Interface Rates Supported

- Supports 1.0625, 2.125, 4.25 or 8.5 Gigabits/second (Gb/s)
- Industry Standard SFP Interface

Programming Languages

Tcl/Tk with graphical interface

Technical Specifications for the SAN Tester Application

Port Type

N_port, Arbitrated loop port (including up to 126 loop devices)

Port Behavior

- Control of port initialization either as FCP or FICON port
- FCP includes control of Flogi, NS registration, RSCN, Discovery, NS Query
- FICON includes control of Flogi, QSA, RNID, RSCN, LIRR

Classes of Service

Class 2 (FICON initialization) and Class 3 traffic

Traffic Profiles

15

Traffic Streams

256 streams per port

Oversized Frame

Oversized frames traffic generation and capture

Interframe Gap

Adjustable from 3 to 1000 IDLEs

Minimum Frame Length

Transmit: 24 bytes, Receive: 24 bytes

Buffer-to-buffer Credit

Adjustable from 1 to 256

Error Generation

Aborted frame, CRC error, oversized frame, invalid SOF, invalid EOF, LOS, Invalid Ordered Sets

Measurements (173x in SAN Tester Mode)

24 real-time measurements including throughput, latency, dropped frames, disparity errors, CRC errors, BB credit, failover recovery time

Result Types

- Cumulative: measurements are reported from the start of the measurement interval
- Instantaneous: measurements are reported from the most recently completed sampling interval

Measurement Clock Resolution

10 ns resolution; ± 0.5 ppm/year clock drift; 3 ppm maximum difference between cards

Measurement Interval

Range: 1 second to 7 days

Display Sampling Interval

Range: 1 second to 1 hour

Test Card Synchronization

All measurements are synchronized across all test cards within the SAN Test System

Capture Memory (in SAN Tester Application)

32 MB real time memory per port

Capture Triggers

8 patterns per port, as well as triggering capabilities on statistics (throughput, latency, sequence error)

Fabric Service Test

- Fabric Zoning test
- Name server performance
- Name server command coverage
- State change notification

Automation

A suite of pre-defined tests in the QuickTest frame work are available, including tests for Throughput, Latency, State Change Notification, Failover recovery time

Technical Specifications for the Protocol Analyzer Application

Analyzers

- Two independent, dual port, full-duplex analyzers per module
- Each analyzer has its own triggering and filtering resources

Traffic Capture

Each analyzer captures bidirectional traffic between 2 fibre channel devices

Memory Size

1 GB per analyzer (2 GB per module)

1733A
1733L
1735A
1736A
1736B

Trigger

- 2 independent multilevel trigger sequencers per module with multiway branching
- Dual channel triggering, trigger on sequence of events in with specified directions (Tx and Rx)
- 8 states per trigger sequencer

Resources

2 counter/timers (for trigger on time-outs) per sequencer

Pattern Matchers

8 128-byte pattern matchers (primitives or frames) with associated local counters

Global Timers

Two 48-bit (7-day) global timers with associated reset

Counters

Two 24-bit global counters that count up/down and have an associated reset

Flexible Visualization

- Easy Flow – GUI feature to highlight protocol interactions in the trace
- Context Sensitive Display – displays only relevant fields to maximize trace understanding

Combinations

'AND' or 'OR' conditions between pattern matchers

Cross Triggering (internal)

Cross-module arm in/out for inclusion in sequencer events coming from another analyzer

Cross Triggering (external)

1 external trigger in/out per chassis

Filters

Hardware filter conditions can be defined individually for each sequence level

Error Detection

Disparity, code violation, CRC error, undersize frames, oversized frames, loss of sync

Frame Truncation

Beginning at the SOF, specified number of FC words are captured to memory – effectively deepening the trace

Resolution

8.3 ns TimeStamp resolution

Time Correlation

- All analyzers in the same session share the same clock to allow for time-correlated measurements
- Time correlation on up to 128 modules (256 analyzers)

Search

High-speed hardware assisted search

Trigger In/Out

1 external trigger in/out per chassis

Technical Specifications for the SAN Director Tester Application

Number of Ports

128 ports per SAN director tester. The 128 ports can be used as two separate 64 port test system

Line Rate

2.125 or 4.25 Gigabits/second (Gb/s). Industry-standard SFP interface. Shipped with 850 nM SFP

Port Type

N_port

Port Behavior

- Includes full parameter control of Flogi
- Ability to enable or disable; NS registration, Discovery of devices, and PLOGI

Classes of Service

Class 3 traffic

Traffic Profiles

15

Traffic Streams

256 streams per port

Oversized Frame

Oversized frames traffic generation

Inter-frame Gap

Adjustable from 3 to 1000 IDLEs

Minimum Frame Length

Transmit: 24 bytes, Receive: 24 bytes

Buffer-to-buffer Credit

Adjustable from 1 to 256

Error Generation

Aborted frame, CRC error, oversized frame, invalid SOF, invalid EOF, LOS, Invalid Ordered Sets

Measurements (173x in SAN Tester Mode)

24 real-time measurements including throughput, latency, dropped frames, disparity errors, CRC errors, BB credit, failover recovery time

Result Types

- Cumulative: measurements are reported from the start of the measurement interval
- Instantaneous: measurements are reported from the most recently completed sampling interval

Measurement Clock Resolution

10 ns resolution; ± 0.5 ppm/year clock drift; 3 ppm maximum difference between cards

Measurement Interval

Range: 1 second to 7 days

Display Sampling Interval

Range: 1 second to 1 hour

Test Card Synchronization

All measurements are synchronized across all test cards within the 1733L SAN Director Test System

Key Literature & Web Link

www.agilent.com/find/fctester

www.agilent.com/find/santester

Ordering Information

The Agilent 173x Series Fibre Channel Test Solution consists of a system controller and multiple chassis hosting 173x Series test cards. The system controller provides a graphical interface to drive the SAN Tester, Protocol Analyzer or SAN Director Tester software applications and the test cards being used. This flexible test system will be able to incorporate new Agilent 173x test cards in the future, thereby protecting your investment.

System Controller

Several system controllers are available, depending on performance requirements. The controller provides an easy-to-use Windows® environment for running the test system software.

N5543A Portable Laptop System Controller

N5544A Standard 1U Rack-mount Server Controller

N5545A High-performance 1U Rack-mount Server Controller

Option

N5545A-AQ2 15-inch Flat Panel Display: 1024 x 768

Chassis

The compact, 4-slot, 2U-high chassis houses up to 4 Fibre Channel test cards. An ultra-compact 2-slot chassis houses up to 2 Fibre Channel test cards. You can easily daisy-chain multiple chassis to support hundreds of test ports in a single test system. You can move hot-swappable test cards between chassis without affecting other test sessions.

N5540A 2-slot, 2U-high chassis

N5541A 4-slot, 2U-high chassis

Fibre Channel Test Card

High-density, scalable Fibre Channel SAN test cards are equipped with powerful traffic generation and measurement capabilities. There are 3 types of cards to choose from depending on your test needs.

1733A 2 Gb/s and 4 Gb/s, 4-port Active Test Card

1735A 1 Gb/s, 2 Gb/s, and 4 Gb/s 2 Port Multifunction Protocol Analyzer and SAN Tester

1736A/B 1 Gb/s, 2 Gb/s, 4 Gb/s and 8 Gb/s Fibre Channel Multifunction Protocol Analyzer and Traffic Generator

Options

173X-A00 Fibre Channel Protocol Analysis License and Software

173X-ST0 SAN Tester License and Software

- **Modular, flexible and scalable design to fit testing needs from a few Mb/s up to 45 Gb/s**
- **Generate complex sequences & analyze data in real-time**
- **Up to 64 parallel input and output channels at rates up to 13.5 Gb/s**
- **Addresses: MUX, FEC, CEI, AMB, PON, PCIe, SAN, GbE, SONET/SDH**



The ParBERT 81250 parallel bit error ratio tester provides extremely fast parallel BER testing for high-speed digital communication ports, components, chips or modules. Application examples are:

- MUX/DeMUX testing up to OC-768
- FEC device testing
- Multiple transmitter/receiver testing; PON
- Characterization of computing ports; SAN, FC, GbE, AMB
- Characterization of communication ports; SONET/SDH
- Differential input and output; SFI-4, SFI-5, Xaui

The ParBERT 81250 is a modular, flexible and scalable platform with a very comprehensive software and measurement suite designed to fit your application needs.

The system generates complete pattern sequences based on pseudo random word sequences (PRWS), user-defined patterns and standard PRBS up to $2^{31}-1$ on parallel lines. Depending on the data module's speed class, the user pattern length is from 2 Mb up to 128 Mb. This enables fast BER measurements as bits are compared in real-time. The BER can be viewed while a measurement is running.

The ParBERT analyzers can automatically synchronize the incoming data stream. Based on the BER measurement the ParBERT offers a measurement suite:

- BER measurement (One-/Zero Errors, accumulated Errors...)
- Fast eye mask measurement (Mask Test with Pass/Fail)
- DUT output timing measurement (RJ, DJ, TJ, Phase Margin)
- Spectral decomposition of jitter (Spectral Jitter Analysis)
- DUT output level measurement (High/Low level, Amplitude, Q-factor)
- Eye opening (3-Dimensional Eye Analysis Voltage-Time-BER)

The ParBERT 81250 offers independently programmable timing and level parameters on every channel. It can generate and analyze single-ended and differential signals – including differential signals to test devices based on logic technologies such as LVDS, ECL and PECL.

The 3.35 Gb/s and 13.5 Gb/s ParBERT Generator modules offer a delay control input for jitter injection for receiver input stress test. With enhanced jitter generation and analysis capabilities and its broad frequency range, the 13.5 Gb/s ParBERT Generator and Analyzer modules are the ideal solution for testing 10 Gb/s devices like OC-192 devices. These modules work with the E4809A clock module only.

Accessories

- 15440A** Adapter Kit: 4* SMA (M) I/O Adapters
- 15441A** Cable Kit: 10*SMA (m) to SCI Connector
- 15442A** Cable Kit: 4*SMA (m) to SMA (m)
- 15443A** Matched Cable Pair
- 15446A** 8-line Trigger Input Pod
- 15447A** Deskew Probe
- N4871A** Cable Kit: SMA Matched Pair, 50 ps
- N4910A** Cable Kit: Matched Cable Pair for 13.5 Gbs
- N4911A-002** Adapter 3.5 mm Female to 2.4 mm Male
- N4912A** 2.4 mm 50 Ohm Termination, Male Connector
- N4913A** 4 GHz Deskew Probe

Key Literature & Web Link

- Agilent ParBERT 81250 Parallel Bit Error Ratio Tester Product Overview, p/n 5968-9188E
- Agilent ParBERT 81250: 10 GbE Testing with 81250 ParBERT Application Note, p/n 5988-8278EN
- 10 GbE Technology and device Characterization Product Note, p/n 5988-6960EN
- Agilent ParBERT 81250 Measuring a real 43.2 Gb/s eye pattern Product Note, p/n 5988-6625EN
- Agilent ParBERT 81250 Automatic Phase Margin Measurements at 43.2 Gb/s, p/n 5988-5654EN
- Jitter Fundamentals: Jitter Tolerance Testing with Agilent 81250 ParBERT Application Note, p/n 5989-0223EN
- Jitter Fundamentals: Agilent 81250 ParBERT Jitter Injection and Analysis Capabilities and Application Note, p/n 5988-9756EN
- 10 GbE Technology and Device Characterization, p/n 5988-6960EN

www.agilent.com/find/parbert

Parallel Bit Error Ratio Tester

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ParBERT 81250 Parallel Bit Error Ratio Tester (cont.)

Specifications

Data Modules

	E4832A	E4861A	E4861B
Maximum Data Rate	675 Mb/s	2.7 Gb/s	3.35 Gb/s
Front End Slots per Module	4	2	2
Memory Depth per Channel	Up to 2 Mb	Up to 8 Mb	Up to 16 Mb
Segments PRBS, PRWS	User defined patterns and PRBS 2^n-1 , $n=7, 9, 10, 11, 15, 23, 31$		
Auto-Synchronization	On PRBS and memory based data by: – Bit synchronization with or without automatic phase alignment – Automatic delay alignment around the start sampling delay		
Usable Front Ends	E4838A E4835A	E4862A E4863A E4864A E4865A	E4862B E4863B

Data Generator Front Ends

	E4838A	E4864A	E4862A	E4862B
Maximum Data Rate	675 Mb/s	1.65 Gb/s	2.7 Gb/s	3.35 Gb/s
Outputs	1, differential or single-ended	1, differential or single-ended	1, differential or single-ended	1, differential or single-ended
Data Format	RZ, R1, NRZ, DNRZ	NRZ, DNRZ clock: duty cycle 50% + 10% typ.	NRZ, DNRZ clock: duty cycle 50% + 10% typ.	NRZ, DNRZ, RZ, R1
Transition Times	0.5 ns – 4.5 ns (0.35 ns typ.) @ ECL (10% – 90%)	90 ps typ. @ ECL, LVDS (110 ps typ. @ $V_{pp\ max}$) (20% – 80%)	90 ps typ. @ ECL, LVDS (110 ps typ. @ $V_{pp\ max}$) (20% – 80%)	<75 ps (60 ps typ.) (20% – 80%)
Amplitude/Resolution	<0.1 to 3.5 V_{pp} /10 mV	0.05 to 1.8 V_{pp} /10 mV	0.05 to 1.8 V_{pp} /10 mV	0.05 to 1.8 V_{pp} /10 mV

Data Analyzer Front Ends

	E4835A	E4865A	E4863A	E4863B
Maximum Data Rate	675 Mb/s	1.65 Gb/s	2.7 Gb/s	3.35 Gb/s
Inputs	2, differential or single-ended	1, differential or single-ended	1, differential or single-ended	1, differential or single-ended
Impedance	50 Ω single-ended 100 Ω differential	50 Ω single-ended 100 Ω differential	50 Ω single-ended 100 Ω differential	50 Ω single-ended 100 Ω differential
Input Threshold	–2.0 to +4.5 V	–2.0 to +3.0 V	–2.0 to +3.0 V	–2.0 to +3.0 V

Data Generator Module

	N4874A	N4872A	E4868B 45 Gb/s MUX Module
Maximum Data Rate	7 Gb/s	13.5 Gb/s	43.2 Gb/s (with E4861A + E4862A) 45 Gb/s (with E4861B + E4862B)
Outputs	1, differential or single-ended	1, differential or single-ended	differential
Data Format	NRZ, DNRZ	NRZ, DNRZ	NRZ
Transition Times	<25 ps (10% – 90%)	<25 ps (10% – 90%)	9 ps typ. (20% – 80%)
Amplitude/Resolution	0.1 to 1.8 V_{pp} /5 mV	0.1 to 1.8 U_{pp} /5 mV	0.5 to 2.0 V single ended/10 mV
Average Output Power Level	—	—	—
Extinction Ratio Range/ Resolution/Accuracy	—	—	—
Memory Depth per Channel	Up to 64 Mb	Up to 64 Mb	128 Mb
Segments PRBS, PRWS	User defined patterns and PRBS 2^n-1 , $n=7, 10, 11, 15, 23, 31$ (HW based)	User defined patterns and PRBS 2^n-1 , $n=7, 10, 11, 15, 23, 31$ (HW based)	User defined patterns and PRBS 2^n-1 , $n=7, 10, 11, 15, 23, 31$ (pure PRBS)
Auto-Synchronization	On PRBS and memory based data by: – Bit synchronization with or without automatic phase alignment – Automatic delay alignment around the start sampling delay		—

Specifications (cont.)

Data Analyzer Module

	N4875A	N4873A	E4869B DEMUX Module
Maximum Data Rate	7 Gb/s CDR around 1/2/4 Gb/s	13.5 Gb/s CDR around 1/2/4/10 Gb/s	43.2 Gb/s (with E4861A + E4863A) 45 Gb/s (with E4861B + E4863B)
Inputs	1, differential or single-ended	1, differential or single-ended	differential
Impedance	50 Ω single-ended 100 Ω differential	50 Ω single-ended 100 Ω differential	50 Ω
Input Threshold	-2.0 to +3.0 V	-2.0 to +3.0 V	± 400 mV
Sensitivity	50 mV	50 mV	50 mV

Clock Module

	E4805B	E4808A	E4809A
Frequency Range	1 kHz to 2.7 GHz	170 kHz to 10.8 GHz	20.8 MHz to 13.5 GHz
Resolution	1 Hz	1 Hz	1 Hz
Accuracy	± 50 ppm with internal PLL reference	± 50 ppm with internal PLL reference	± 50 ppm with internal PLL reference
Clock Jitter	<10 ps rms (5 ps typ.)	<10 ps rms (5 ps typ.)	~ 2 ps rms
Compatible Data Modules	E4832A/E4861A	E4832A/E4861A/ E4861B/E4868B/ E4869B/E4810A/ E4811A	E4832A/E4861B/ E4810A/E4811A/ N4871A/N4872A/ N4874A/N4875A

Ordering Information

Mainframe

81250A ParBERT 81250

81250A-013 IEEE 1394 PC link to VXI

81250A-014 External PC

81250A-015 Laptop including PCMCIA IEEE 1394 Card

81250A-149 Mainframe

81250A-152 IEEE 1394 'FireWire' Expander Frame

Software

E4875A One License and Software CD ROM for ParBERT 81250

Clock Modules

E4805B 675 MHz Central Clock Module

E4808A High Performance Central Clock Module

E4809A 13.5 GHz Central Clock Module

Data Modules & Front Ends

E4832A 675 Mb/s Generator/Analyzer Module

E4835A Two Differential Analyzer Front-ends, 675 Mb/s

E4838A Differential Generator Front-end, 675 Mb/s

E4861A 2.7 Gb/s Generator/Analyzer Module

E4864A Generator Front-end 1.65 Gb/s

E4865A Analyzer Front-end 1.65 Gb/s

E4862A Generator Front-end 2.7 Gb/s

E4863A Analyzer Front-end 2.7 Gb/s

E4861B 3.35 Gb/s Generator/Analyzer Module

E4862B Generator Front-end 3.35 Gb/s

E4863B Analyzer Front-end 3.35 Gb/s

N4874A Generator Module 7 Gb/s

N4875A Analyzer Module 7 Gb/s

N4872A Generator Module 13.5 Gb/s

N4873A Analyzer Module 13.5 Gb/s

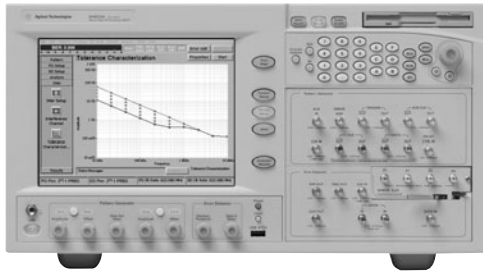
E4868B 45/43.2 Gbit/s Multiplexer Module

E4869B 45/43.2 Gbit/s Demultiplexer Module

81250
N4875A
N4873A
E4811A
E4869B
E4805B
E4808A
E4809A

N4903A

- Operating range 150 Mb/s to 7 Gb/s or to 12.5 Gb/s provides enough margin for today's and tomorrow's serial interfaces
- Built-in, compliant and calibrated jitter injection with >0.5 UI (option J10). All in one box: PJ, SJ, RJ, BUJ for stressed eye testing of a receiver
- Interference channel plug-in with ISI and sinusoidal interference for emulating channel and noise effects (option J20)
- Automated jitter tolerance test saves programming time (option J10)
- Transition times <20 ps and jitter <9 ps pp for accurate measurements
- Built-in Clock Data Recovery (CDR). Tunable loop bandwidth and compliant CDR settings (option CTR)
- Differential pattern and clock generation and differential analysis
- Sub-rate clock outputs with any ratio 1:n
- Bit recovery mode to analyze undeterministic traffic (option A01)
- External Delay Control Input for injection of external jitter
- SSC clocking (option J11)
- Fast Total Jitter and measurement suite
- Remote programmable via GPIB, LAN, and USB interfaces. Compatible with existing command set Agilent 71612, 81630 series, N4900 series
- Bench use with intuitive touch-screen user interface based on Windows XP
- Applications: PCI Express®, SATA, Fully-buffered DIMM, Display Port, Fibre Channel, CEI, 10 Gb Ethernet, XFP/XFI



The Smartest Way to Accurate Jitter Tolerance Test and Characterization

The J-BERT N4903A High-Performance Serial BERT provides the only complete jitter tolerance test solution for characterization of serial gigabit devices.

It offers complete, integrated and calibrated jitter composition for stressed eye testing of receivers up to 12.5 Gb/s. Automated and compliant jitter tolerance testing allows quick and accurate characterization for all popular serial bus standards, such as PCI Express, SATA, FB-DIMM, Display Port, Fibre Channel, CEI, 10 Gigabit Ethernet and XFP/XFI.

The J-BERT matches the latest serial bus interfaces perfectly with its ability to analyze undeterministic traffic with idles from the DUT with the analyzer's Bit Recovery Mode. The pattern generator allows setting up complex pattern sequences to bring a device into loop back mode. To match LVDS and other low voltage standards, all clock, data inputs and outputs are differential and can handle small amplitude swings.

Clockless interfaces can be analyzed with the built-in CDR with tunable loop bandwidth (option CTR). The J-BERT offers differential substrate clock outputs with any ratio of clock and data signals without extra equipment. Data and clock outputs support spread Spectrum Clocking (SSC), commonly used in computer bus standards.

The J-BERT is an expandable, future-proof BERT platform where all options can be configured to the current test needs and upgraded later when those needs change.

It is the ideal choice for R&D and validation teams who characterize and stress chips and transceiver modules with serial I/O ports up to 12.5 Gb/s.

Specifications

Pattern Generator

Operation Range

Internal clock: 620 Mb/s to 12.5 Gb/s (option C13 and G13) or 7 Gb/s (option C07 and G07)

External clock: 150 Mb/s to 12.5 Gb/s (option C13 and G13) or 7 Gb/s (option C07 and G07)

Data Output

1, differential or single-ended

Output Amplitude

0.1 Vpp – 1.8 Vpp

Jitter

<9 ps pp

Transition Time

<25 ps (10% to 90% and ECL levels)

Crossing Point Adjustable

20% – 80%

Pattern

PRBS 2ⁿ–1, n = 7, 10, 11, 15, 23, 31

User-definable memory: 32 Mbit and pattern sequencing

Delay Control Input

200 ps @ 1 GHz

Jitter Tolerance Test

Jitter Sources, Built-in & Calibrated (option J10)

Random Jitter: 0 to 14 ps rms, up to 1 GHz

Periodic Jitter: sinewave, rectangular modulation up to 20 MHz,

sinusoidal modulation up to 300 MHz

Sinusoidal Jitter: multiple UIs up to 5 MHz

Bounded Uncorrelated Jitter: up to 200 ps pp; according CEI

SSC Clocking (option J11)

triangular modulation – 0.5% @ 28 to 34 kHz on data and clock outputs

Interference Channel (option J20)

ISI: Intersymbol interference by switchable board traces

Sinusoidal Interference: vertical eye closure, common and differential mode

Error Detector:

Operation Range

Internal clock: 500 Mb/s to 12.5 Gb/s (option C13) or 7 Gb/s (option C07)

External clock: 150 Mb/s to 12.5 Gb/s (option C13) or 7 Gb/s (option C07)

Data Input

1, differential or single-ended

Delay Adjust

±0.75 ns

Clock Data Recovery

Fixed loop bandwidth: data rate/1667

Variable loop bandwidth (option CTR): 100 kHz to 12 MHz

Sensitivity

<50 mV

Measurement Suite

BER, accumulated, intervals

BERT Scan, "bathtub" curve includes RJ, DJ, TJ

Output Level

Eye Diagram with BER contour and eye masks

Fast Eye Mask

Spectral Jitter

Error Location Capture

Fast Total Jitter Measurement

Accessories

N4910A 2.4 mm Matched Cable Pair
N4911A-002 One Adapter 3.5 mm (f) to 2.4 mm (m)
N4912A One 50 Ohm Termination, 2.4 mm (m)
N4915A-001 One 47 ps Transition Time Converter
N4915A-002 Short Cable Kit for Connecting ISIS Ports
(included in option J20)
N4915A-003 Short Clock Cable (included in option J20)
N4916A De-emphasis Signal Converter

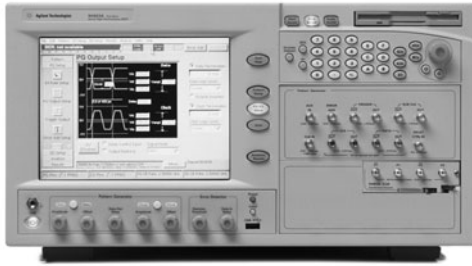
Key Literature & Web Link

www.agilent.com/find/j-bert

Ordering Information

N4903A J-BERT High-Performance Serial BERT 12.5 Gb/s,
(includes 5 x 50 Ohm terminations, 6 x adapter SMA to 2.4 mm, USB cable,
no signal cables)
N4903A-C07 Pattern Generator & Error Detector
150 Mb/s to 7 Gb/s with Built-in CDR
N4903A-C13 Pattern Generator & Error Detector
150 Mb/s to 12.5 Gb/s with Built-in CDR
N4903A-G07 Pattern Generator 150 Mb/s to 7 Gb/s
N4903A-G13 Pattern Generator 150 Mb/s to 12.5 Gb/s
N4903A-A01 Bit Recovery Mode
N4903A-CTR Compliant and Tunable Loop Bandwidth
N4903A-J10 Jitter Sources: RJ, PJ, SJ, BUJ
N4903A-J11 SSC Generation
N4903A-J12 Automated Jitter Tolerance Compliance Software
N4903A-J20 Interference Channel: ISI, Sinusoidal Interference
(includes N4915A-002, N4915A-003)

- Operating range 150 Mb/s to 7 Gb/s or to 12.5 Gb/s provides enough margin for today's and tomorrow's serial interfaces
- Built-in, compliant and calibrated jitter injection with >0.5 UI (option J10). All in one box: PJ, SJ, RJ, BUJ for stressed eye testing of a receiver
- Interference channel plug-in with ISI and sinusoidal interference for emulating channel and noise effects (option J20)
- Transition times <20 ps and jitter <9 ps pp for accurate measurements
- Differential pattern and clock generation
- Sub-rate clock outputs with any ratio 1:n
- 32 Mbit pattern memory and pattern sequencer
- External delay control input for injection of any external jitter
- SSC clocking (option J11)
- Upgrade path to error detector and complete J-BERT functionality
- Remote programmable via GPIB, LAN, and USB interfaces. Compatible with existing command set Agilent 71612, 81630 series, N4900 series
- Bench use with intuitive touch-screen user interface based on Windows® XP
- Applications: PCI Express, SATA, fully-buffered DIMM, Display Port, Fibre Channel, CEI, 10 Gb Ethernet, XFP/XFI



Fast and Accurate Characterization of Gigabit Devices

The J-BERT N4903A pattern generator options for data rates up to 7 Gb/s and 12.5 Gb/s provide a complete pattern generator functionality in combination with jitter injection. Design and test engineers can quickly and accurately stimulate serial high-speed ports, such as Display Port, PCI Express, SATA, fully-buffered DIMM, Fibre Channel, CEI, Gigabit Ethernet and XFP/XFI. The J-BERT pattern generators can be used in combination with oscilloscopes, built-in error detectors or other analyzers.

The J-BERT pattern generator provides digital data patterns with all types of calibrated and integrated jitter for stressing the device under test: random, periodic, sinusoidal, bounded-uncorrelated jitter, intersymbol interference and sinusoidal interference.

Accurate measurements are possible with the pattern generators excellent signal performance with the fastest transition times, and low jitter.

The J-BERT N4903A pattern generator simplifies testing of the latest serial bus interfaces. Complex training sequences required to bring a device into loop back mode, can be setup easily with the pattern sequencer. To match LVDS and other low voltage standards, all clock, data inputs and outputs are differential and can handle small amplitude swings. The J-BERT pattern generator offers differential sub rate clock outputs with any ratio of clock and data signals without extra equipment. Data and clock outputs support Spread Spectrum Clocking (SSC), commonly used in computer bus standards.

The J-BERT N4903A pattern generator can be upgraded to a complete J-BERT with error detectors later when test needs change.

Specifications

Pattern Generator

Operation Range

Internal clock: 620 Mb/s to 12.5 Gb/s (option G13) or 7 Gb/s (option G07)
External clock: 150 Mb/s to 12.5 Gb/s (option G13) or 7 Gb/s (option G07)

Data Output

1, differential or single-ended

NRZ

Output Amplitude

0.1 V_{pp} – 1.8 V_{pp}

Jitter

<9 ps pp

Transition Time

<25 ps (10% to 90% and ECL levels)

Crossing Point Adjustable

20% – 80%

Pattern

PRBS 2ⁿ–1, n = 7, 10, 11, 15, 23, 31

User-definable pattern: 32 Mbit

Generator pattern sequencer: 4 blocks

Delay Control Input

200 ps @ 1 GHz

Jitter Injection, Built-in and Calibrated (option J10)

Random Jitter: 0 to 14 ps rms, up to 1 GHz

Periodic Jitter: sinewave, rectangular modulation up to 20 MHz, sinusoidal modulation up to 300 MHz

Sinusoidal Jitter: multiple UIs up to 5 MHz

Bounded Uncorrelated Jitter: up to 200 ps pp; according CEI

SSC Clocking (option J11)

triangular modulation – 0.5 % @ 28 to 34 kHz on data and clock outputs

Interference Channel (option J20)

ISI: Intersymbol interference by switchable board traces

Sinusoidal Interference: vertical eye closure, common and differential mode

Accessories

N4910A 2.4 mm Matched Cable Pair

N4911A-002 One Adapter 3.5 mm (f) to 2.4 mm (m)

N4912A One 50 Ohm Termination, 2.4 mm (m)

N4915A-001 One 47 ps Transition Time Converter

N4915A-002 Short Cable Kit for Connecting ISI Ports (included in -J20)

N4915A-003 Short Clock Cable (included in -J20)

N4916A De-emphasis Signal Converter

Key Literature & Web Link

www.agilent.com/find/j-bert

Ordering Information

N4903A-G07 Pattern Generator 150 Mb/s to 7 Gb/s

N4903A-G13 Pattern Generator 150 Mb/s to 12.5 Gb/s

N4903A-J10 Jitter Sources: RJ, PJ, SJ, BUJ

N4903A-J11 SSC Generation

N4903A-J20 Interference Channel: ISI, Sinusoidal Interference

- Excellent price/performance ratio
- Variable frequency up to 3.6 Gb/s or 12.5 Gb/s
- <25 ps transition time
- <50 mV pp input sensitivity
- Fast Eye Mask Measurement for pass/fail testing (Option 101)
- True differential data generation and analysis capability (Option 101)
- Enhanced Measurement Suite (Option 101)
- Integrated Clock Data Recovery (Option 102)
- Small form factor saves bench or rack space
- LAN, USB, GPIB for remote control
- Compatibility with existing remote commands, e.g. Agilent 71612, 86130A series and N4900 Series
- Color touch screen, Windows XP
- Applications: manufacturing test, Telecom transceivers such as SONET/SDH Fibre Channel, 10 GbE, XFP/XFI, PON-OLT's and high-speed serial computer buses



The Serial BERT N4906B is a general-purpose bit error ratio tester designed for testing high-speed digital communication components and systems.

It is ideal for cost-effective manufacturing and telecom device testing.

It offers a 3.6 Gb/s or 12.5 Gb/s pattern generator and error detector with excellent price/performance ratio.

Transition times <25 ps allow precise measurements.

The analyzer can be configured with CDR to test clockless interfaces and with true differential inputs to test LVDS and other differential interfaces.

The compact size of the N4906B saves rack space; LAN, USB and GPIB interfaces allow smooth integration into automated test environments.

For bench users the N4906B Serial BERT offers an intuitive user interface with state-of-the-art Windows-XP based touch-screen.

Deeper insight into the device's performance can be obtained with the enhanced measurement suite. It offers many valuable signal analysis tools, such as BERT Scan (so-called bathtub curves) with total jitter and its separation into RJ and DJ, eye contours, spectral jitter decomposition and more.

Specifications

Pattern Generator

Operation Range

9.5 Gb/s to 12.5 Gb/s (Option 012)
150 Mb/s to 12.5 Gb/s (Option 102)
150 Mb/s to 3.6 Gb/s (Option 003)

Data Output

1, differential or single-ended

Output Amplitude

0.10 V to 1.8 V in 5 mV steps

Jitter

9 ps pp typical

Transition Time

<25 ps (10% to 90% and ECL levels)

Cross Point Adjust

20% – 80%

Pattern

PRBS 2ⁿ–1, n = 7, 10, 11, 15, 23, 31
User-definable memory: 32 Mbit

Error Detector

Operation Range

9.5 Gb/s to 12.5 Gb/s
150 Mb/s to 12.5 Gb/s (Option 102)

Data Input

1, single-ended or differential (Option 101 or 003)

Delay Adjust

1.5 ns

Clock Data Recovery (Option 102)

1.058 to 1.6 Gb/s, loop bandwidth 1 MHz typ.
2.115 to 3.2 Gb/s: loop bandwidth 2 MHz typ.
4.23 to 6.4 Gb/s: loop bandwidth 4 MHz typ.
9.9 to 10.9 Gb/s: loop bandwidth 8 MHz typ.

Sensitivity

<50 mV

Measurements

BERT

Fast Eye Mask Measurement with pass/fail (Option 101)

BERT Scan with RJ/DJ separation (Option 101)

Fast Total Jitter (Option 101)

Spectral Jitter Decomposition (Option 101)

Eye Contour (Option 101)

Output Level (Option 101)

Error Location Capture (Option 101)

Accessories

N4910A 2.4 mm Matched Cable Pair

N4915A-001 One 47 ps Transition Time Converter

Key Literature & Web Link

www.agilent.com/find/N4900_Series

Ordering Information

N4906B-012 Serial BERT 12.5 Gb/s; Pattern Generator & Error Detector; 4 x 50 Ω terminations; 6 x 2.4 mm to 3.5 mm APC converter; No cables included

N4906B-101 Differential Analysis, Fast Eye Mask and Enhanced Measurement Suite (only applicable with N4906B-012)

N4906B-102 Extension to full frequency range 150 Mb/s to 12.5 Gb/s + Clock Data Recovery (only applicable with N4906B-012)

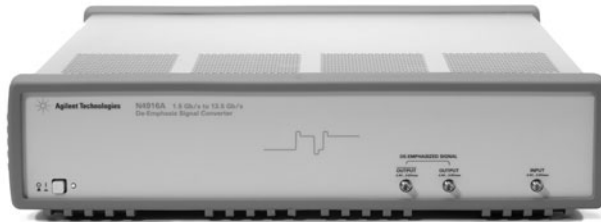
N4906B-003 Serial BERT 3.6 Gb/s Pattern Generator & Error Detector; 4 x 50 Ω terminations; 6 x 2.4 mm to 3.5 mm APC converter; No cables included

Serial Bit Error Ratio Tester

210

De-Emphasis Signal Converter N4916A

- Variable de-emphasis post-cursor up to 12 dB in 0.1 dB steps
- Supports data rates up to 13.5 Gb/s
- Differential outputs
- Operation via integrated user-interface of the J-BERT N4903A and the 81141A and 81142A serial pulse data generators
- Jitter feed-through for worst-case testing



De-emphasis Signal Injection Enables Robust Receiver and Board Designs

The N4916A de-emphasis signal converter enables design and test engineers to accurately characterize gigabit serial ports and channels that operate with de-emphasized signals. This results in more robust receiver designs, with reliable operation in real printed circuit board environments.

De-emphasis is a commonly used technique for transmitting electrical signals at gigabit data rates to compensate for the losses caused by PC board traces.

Many popular serial bus standards, such as Display Port, PCI Express®, SATA 3 Gb/s, fully-buffered DIMM, Hypertransport, CEI, 10 Gigabit Ethernet require transmit de-emphasis.

The de-emphasis signal converter can be controlled via the graphical user interface of the J-BERT N4903A serial high-performance BERT and the 81141/42A serial pulse data generator.

Specifications

Operation Range

1.5 Gb/s to 13.5 Gb/s (12.5 Gb/s max. with J-BERT N4903A)

Format NRZ

Output Amplitude

Differential: 200 mV to 1.6 V

Single-ended: 100 mV to 0.8 V

De-emphasis Amplitude Ratio

0 dB to 12 dB, in 0.1 dB steps

Interface 2.4mm (f), DC coupled 50 Ohm

Accessories

N4910A 2.4 mm Matched cable pair

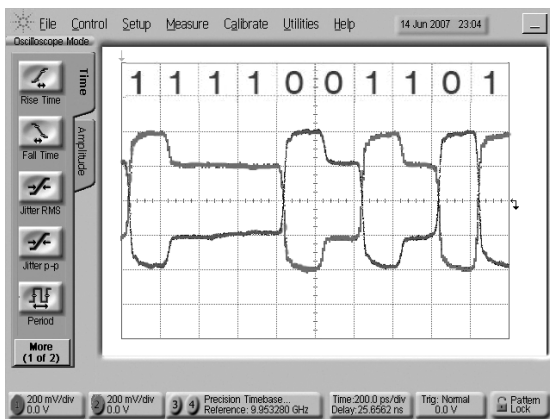
N4915A-004 One 2.4 mm cable (m-m)

Key Literature & Web Link

www.agilent.com/find/n4916

Ordering Information

N4916A De-emphasis Signal Converter, includes one 50 Ohm termination SMA, one 2.4 mm to SMA adapter. No signal cables included.



- Standard measurements at rates between 125 Mb/s and 3.125 Gb/s
- Generation of Pseudo Random Bit Sequence (PRBS) polynomials and a K28.5 pattern at Low Voltage Differential Signal (LVDS) or Emitter Coupled Logic (ECL) levels
- Flexible connections to the device under test via 3.5 mm differential electrical coax connectors and/or standard optical SFP module plug-ins
- Optical and electrical error injection (once or at selectable Bit-Error-Ratio)
- Analysis of gated Bit-Error-Ratio with display of the absolute number of errors and selectability of gate time
- Dramatically simplified transceiver measurements that provide just the essential tests via the one page graphical user interface (running on an external Windows® XP PC via a USB 2.0 interface)
- Full programmability of all graphical user interface features from another software program, making automation in manufacturing an easy task



The Agilent N5980A 3.125 Gb/s Serial BERT is ideal for manual or automated manufacturing test of electrical and optical devices running at speeds between 125 Mb/s and 3.125 Gb/s. It addresses all common standard speeds via selectable bit rates.

Easy-to-use and Cost Efficient

The software user interface has one standard or one advanced screen to ensure intuitive use for operators. It makes the instrument easy to use and easy to learn.

Twice the Measurement Throughput

By using both the electrical and optical (SFP) interfaces concurrently, you can double your measurement throughput (electrical in/optical out and vice versa).

Automation Made Easy

The remote programmability of the user interface, using SCPI – syntax, makes it simple to integrate the N5980A into other programs.

PRBS, K28.5 Pattern or Clock Generation and Integrated Clock Data Recovery

The N5980A can generate standard PRBS polynomials, K28.5 ('Comma') characters and different sub-rate clocks (/2 to /20). It can also inject errors with an adjustable error ratio. The receiver has a clock-data – recovery (CDR) built-in and differential inputs (SMA) for signals from 50 mVpp to 2 Vpp amplitude.

Standard (SFP) Optical Module Plug-in

The instrument has a standard SFP- female connector. This enables all different kind of user-selectable optical modules (e.g for multi-mode/single-mode fiber at 850 nm, 1310 nm and 1550 nm for the test set-up).

Small Size

Its very small size allows the N5980A to fit on any bench and in any automated setup. The dimensions are, 228 mm (W) x 59 mm (H) x 246 mm (D) (Bench top dimensions).

Specifications

Data Rates

Fast Ethernet: 125 Mb/s
 OC-3: 155.52 Mb/s
 OC-12: 622.08 Mb/s
 OC-48: 2.48832 Gb/s
 OC-48 with FEC: 2.66606 Gb/s
 1 x FC: 1.0625 Gb/s
 2 x FC: 2.125 Gb/s
 1 x Gigabit Ethernet: 1.25 Gb/s
 XAUI: 3.125 Gb/s
 Accuracy: ± 50 ppm

Operating System

The software supplied runs on Windows 2000 or XP with .NET v2.0, by a USB 2.0 interface

Pattern Generator

Pattern

PRBS: 2^7-1 , $2^{15}-1$, $2^{23}-1$, $2^{31}-1$

Data pattern: K28.5

Clock pattern: data rate divide by n, n = 2, 4, 8, 10, 16, 20

The pattern can be individually adjusted for pattern generator electrical out and optical out

Error Injection

Fixed electrical and optical error inject:

Fixed error ratios of 1 error in 10^6 bits, n = 3, 4, 5, 6, 7, 8, 9

Single error injection

Separate error ratios can be adjusted for pattern generator electrical out and optical out

Pattern Generator Electrical Out

A differential electrical output is provided on the front-panel

Output Amplitude

ECL

850 mVpp typ., single-ended

1700 mVpp typ., differential

LVDS

400 mVpp typ., single-ended

800 mVpp typ., differential

Jitter

0.05 UI typ. @ OC-12

0.08 UI typ. @ GbE

0.15 UI typ. @ OC-48

Pattern Generator Optical Out

A standard SFP housing is provided

Minimum number of insertion/deinsertion cycles: 200

Error Detector

A differential electrical input is provided on the front-panel

Data rate is the same as pattern generator

Pattern

The following patterns are supported:

PRBS: 2^7-1 , $2^{15}-1$, $2^{23}-1$, $2^{31}-1$

Data Input

differential AC coupled

Max. Input Amplitude

1 Vpp, single-ended

2 Vpp, differential

Clock Data Recovery

Internal CDR

Impedance

100 Ohms nominal

Sensitivity

<50 mV

Synchronization

Automatically on level, polarity, phase, bit and pattern

Operating System

The software supplied runs on Windows 2000 or XP with .NET v2.0, by a USB 2.0 interface

Key Literature & Web Link

www.agilent.com/find/manufacturing_bert

Ordering Information

N5980A 3.125 Gb/s Serial BERT

N2099A

- **Cost effective synthesizer for optical transceiver manufacturing**
- **Flexible Modular PXI platform allows multiple instruments and configurations**
- **Tuning range of 2 GHz**
- **Highly accurate source**
- **Center frequencies available between 4 and 11 GHz**
- **Two RF outputs**
- **10 MHz reference output**

The N2099A PXI Synthesizer is a high quality microwave source capable of 2 GHz tuning range. Available with one of a number of factory-set center frequencies in the range of 4 to 11 GHz.

The N2099A is part of a family of Agilent PXI products that are focused at providing test equipment for optical transceiver manufacturers.

Optical transceiver manufacturers can combine the N2099A PXI Synthesizer with the N2102 PXI Pulse Pattern Generator as a complete source for controlling the transmitter portion of the transceiver.

For optical or electrical analysis of eye diagrams the N2100A PXI Digital Communication Analyzer can be included in the system.

Other related PXI products:

N2100A PXI Digital Communication Analyzer

N2101A PXI Bit Error Ratio Tester

N2102A PXI 8.5 Gb/s Pulse Pattern Generator



Specifications

Parameter Specification

Output Frequency (center): 4, 5, 6, 7, 8, 9, 10, 11 GHz

Tuning Range: ± 1.0 GHz

Output Power Min.: +9 dBm (4, 5 and 6 GHz)
+7 dBm (7, 8, 9, 10 and 11 GHz)

Power Variation Over Temp/Freq: ± 2 dB

Step Size Min: 1 kHz

Switching Speed, 100 MHz Step: 100 ms typical

Output Impedance: 50 Ohms

External Ref. Osc. Output Freq (TCXO): 10 MHz

Accessories

The N2099A PXI Synthesizer requires: A PXI mainframe with either a PXI embedded controller or a PXI interface card to connect to an external PC

Key Literature & Web Link

Agilent PXI Synthesizer Data Sheet, p/n 5989-6071EN

Agilent 7 GHz Digital Communications Analyzer Data Sheet, p/n 5989-6070EN

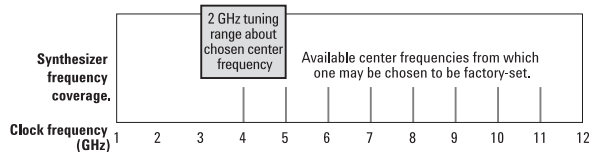
Agilent 5 Gb/s Bit Error Ratio Tester Data Sheet, p/n 5989-6069EN

Agilent PXI 8.5 Gb/s Pulse Pattern Generator Data Sheet, p/n 5989-6071EN

www.agilent.com/find/pxit

Ordering Information

N2099A-H10-n Synthesizer. Replace n with the center frequency required: n = 4, 5, 6, 7, 8, 9, 10 or 11 (GHz)



- Cost effective pattern generator for optical transceiver manufacturing
- Flexible Modular PXI platform allows multiple instruments and configurations
- Significantly smaller than a traditional pattern generator
- Wide bit rate coverage from 1 Gb/s to 8.5 Gb/s
- Differential outputs
- Standard patterns include PRBS, K28.5, K28.7
- User defined patterns



The N2102A Pulse Pattern Generator is a single slot PXI instrument capable of generating a number of low jitter patterns at rates up to 8.5 Gb/s using an externally supplied clock.

ActiveX drivers provide easy to use software, remote control, and a graphical user interface is provided for manual operation of the module.

The N2102A is part of a family of Agilent PXI products that are focused at providing test equipment for optical transceiver manufacturers.

Optical transceiver manufacturers can combine multiple N2102A pattern generators within a mainframe for controlling multiple transceivers simultaneously, along with multiple N2100A PXI Digital Communication Analyzer.

Other Related PXI products:

- N2100A PXI Digital Communications Analyzer
- N2101A PXI Bit Error Ratio Tester
- N2099A PXI Synthesizer

Specifications

Bit Rate Operation Bands: Bands between 1.0 and 8.5 Gb/s

Output Rise/Fall Time (20% – 80%): 35 ps typical

Output Intrinsic Jitter: 2 ps RMS

Output Voltage Range: 25 mV – 1.6 V p-p

Output Voltage Resolution: 5 mV

Output Clock Level: +10 dBm at 8.5 GHz

Maximum Input Clock Level: +3 dBm at 8.5 GHz

Front Panel Connectors: SMA

Accessories

The N2102A requires: A clock input, for example a N2099A PXI Synthesizer

A PXI mainframe with either a PXI embedded controller or a PXI interface card to connect to an external PC

Key Literature & Web Link

Agilent PXI 8.5 Gb/s Pulse Pattern Generator Data Sheet, p/n 5989-6071EN

Agilent PXI Synthesizer Data Sheet, p/n 5989-6071EN

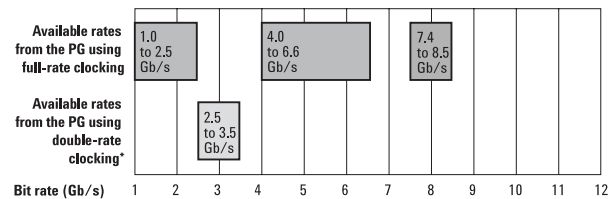
Agilent 7 GHz Digital Communications Analyzer Data Sheet, p/n 5989-6070EN

Agilent 5 Gb/s Bit Error Ratio Tester Data Sheet, p/n 5989-6069EN

www.agilent.com/find/pxit

Ordering Information

N2102A-H10 8.5 Gb/s Pulse Pattern Generator



* Rates available by using a clock between 5.0 to 7.0 GHz, and setting the PG instrument to the clock frequency divided by two – it automatically takes the double-rate into account.

N2101A

- **Cost effective BERT for optical transceiver manufacturing**
- **Flexible Modular PXI platform allows multiple instruments and configurations**
- **Significantly smaller than a traditional BERT**
- **Fixed internal clock rates 1.0625, 1.25, 2.125, 2.488, 2.5, 4.25, 5.0 Gb/s**
- **Data pattern generation, error detection and clock source combined in one module**
- **Bathtub jitter measurement capability**



3

The N2101A PXI 5 Gb/s BERT consists of a clock source, data pattern generator and error detector within a 2U wide PXI module.

Easily perform bit error ratio analysis to characterize the quality of devices from 1.0625 to 5 Gb/s.

The N2101A is part of a family of Agilent PXI products that are focused on providing cost effective test equipment for optical transceiver manufacturers.

Optical transceiver manufacturers can measure all required test parameters by combining the N2101A 5 Gb/s BERT with the N2100A Digital Communications Analyzer.

Other related PXI products:

N2099A PXI Synthesizer

N2100A PXI Digital Communication Analyzer

N2102A PXI 8.5 Gb/s Pulse Pattern Generator

Specifications

Pattern Generator

Output Jitter: 2 ps RMS

Rise/Fall Time (20 – 80%): 35 ps max

Output Range: 250 mV – 1.6 V peak-peak

Amplitude Resolution: 5 mV

Error Detection

Input Range: 50 mV – 2 V

Input Sensitivity: 50 mV

Trigger Output Options: Clock Div 8, Div 9, Div 128 and Pattern Trigger

Output Amplitude DC Coupled: 500 mV peak-peak

Accessories

The N2101A requires: A PXI mainframe and either a PXI embedded controller or a PXI interface card to connect to an external PC

Key Literature & Web Link

Agilent 5 Gb/s Bit Error Ratio Tester Data Sheet, p/n 5989-6069EN

Agilent 7 GHz Digital Communications Analyzer Data Sheet,

p/n 5989-6070EN

Agilent PXI 8.5 Gb/s Pulse Pattern Generator Data Sheet,

p/n 5989-6071EN

Agilent PXI Synthesizer Data Sheet, p/n 5989-6071EN

www.agilent.com/find/pxit

Ordering Information

N2101A-H10 5 Gb/s Bit Error Rate Tester. Includes pattern generation

and error detection in a single module. 3U high, 2U wide PXI module

Requires PXI mainframe and controller, sold separately.

- Cost effective DCA for optical transceiver manufacturing
- Flexible Modular PXI platform allows multiple instruments and configurations
- Significantly smaller than a traditional DCA
- Eye diagram, jitter and mask testing
- High throughput
- Multimode and single-mode fiber input
- Single ended electrical input
- Three standard hardware filter rates GigE, 2xFC, 4xFC
- Digital filter capability
- Multiple measurement capability
- Unique vector sampling technique

The N2100A implements a patented coherent vector under-sampling which allows fast data acquisition and multiple eye measurements for higher test throughput.

This PXI instrument uniquely combines the functionality of several traditional instruments in a single PXI module. Perform accurate eye diagram analysis to characterize the quality of transmitters from 50 Mb/s to 4.25 Gb/s.

The N2100A is part of a family of Agilent PXI products that are focused on providing test equipment for optical transceiver manufacturers.

Optical transceiver manufacturers can measure all required test parameters by combining the N2101A 5 Gb/s BERT with the N2100A Digital Communication Analyzer.

Other related PXI products:

N2099A PXI Synthesizer

N2101A PXI Bit Error Ratio Tester

N2102A PXI 8.5 Gb/s Pulse Pattern Generator

Specifications

Electrical¹

Bandwidth of Electrical Input: 0.1 to 7000 MHz (characteristic)

Internal Clock Recovery: 155 to 3000 MHz

Clock Recovery Lock Range: 250 ppm

External Clock Reference: 5 to 300 MHz

External Clock Input Range (CML): 200 to 3000 mV

External Clock Lock Range: ± 150 ppm

Transition Time (20% to 80%): 35 pS

Maximum Input Range (p-p): 1500 mV

Input noise (rms): 0.75 mV

Optical¹

Standard Switchable Filters: 1.25, 2.125, 4.25 Gb/s compliance filters²

Unfiltered Optical BW: 7.0 GHz

Optical Responsivity: 780 – 1600 nm

Optical Noise Equivalent Power: –28 dBm

Mask Sensitivity at 850 nm: –10 dBm

Mask Sensitivity at 1310/1550 nm: –12 dBm

Overload Optical Input: 2 dBm

Average Optical Power Monitor: –15 to 2 dBm

Fiber Input: 9, 50, 62.5 μ m



Accessories

The N2100A requires: A PXI mainframe with either a PXI embedded controller or a PXI interface card to connect to an external PC

Key Literature & Web Link

Agilent 7 GHz Digital Communications Analyzer Data Sheet, p/n 5989-6070EN

Agilent 5 Gb/s Bit Error Ratio Tester Data Sheet, p/n 5989-6069EN

Agilent PXI 8.5 Gb/s Pulse Pattern Generator Data Sheet, p/n 5989-6071EN

Agilent PXI Synthesizer Data Sheet, p/n 5989-6071EN

www.agilent.com/find/pxit

Ordering Information

N2100A-H10 7 GHz Optical Bandwidth DCA. Equipped with compliance filters suitable for 1GbE, 2x and 4x Fibre Channel. 9 GHz single ended electrical input. 3 slot PX card, requires PXI mainframe and controller sold separately.

¹ The N2100A is not recommended for use at 3.125 Gb/s with a PRBS-7 pattern.

² Consult factory for alternative options.



Agilent offers a full line of digital multimeters.



L4400



34405A



U1251A & U1252A



34410A & 34411A

Selection Table for Digital Multimeters, Voltmeters

Product	Type	Basic Measurements	Additional Measurements	Connectivity
U1251A	NEW! Handheld digital multimeter, 4½ digit	dc & ac voltage, dc & ac current, resistance, continuity, diode test	Frequency, capacitance, temperature, manual data storage	IR to USB (optional connectivity cable sold separately)
U1252A	NEW! Handheld digital multimeter, 4½ digit	dc & ac voltage, dc & ac current, resistance, continuity, diode test	Frequency, capacitance, temperature, data storage capability, 20 MHz frequency counter, square wave generator	IR to USB (optional connectivity cable sold separately)
34405A	Digital multimeter, 5½ digits	dc & ac voltage, dc & ac current, 2 wire Ω, frequency	Continuity, diode test, capacitance, temperature	USB 2.0
34401A	Digital multimeter, 6½ digit	dc & ac voltage, dc & ac current, 2 & 4 wire Ω, frequency & period	Continuity, diode test	IntuiLink software with built-in GPIB and RS-232
34410A	Next generation high performance digital multimeter, 6½ digit with dual display	dc & ac voltage, dc & ac current, 2 & 4 wire Ω, frequency, period, 10,000 rdgs/s	Continuity, diode test, capacitance, temperature, front panel data logger, dB measurements, dBm measurements, statistics, limit testing	LAN, USB 2.0, and GPIB standard, Web browser interface, IntuiLink software
34411A	Next generation high speed digital multimeter, 6½ digit with waveform capture	dc & ac voltage, dc & ac current, 2 & 4 wire Ω, frequency, period, 50,000 rdgs/s, analog level trigger	Continuity, diode test, capacitance, temperature, front panel data logger, dB measurements, dBm measurements, statistics, limit testing	LAN, USB 2.0, and GPIB standard, Web browser interface, IntuiLink software
L4411A	NEW! Enhanced Performance system Digital Multimeter, 6½ digits	dc & ac voltage, dc & ac current, 2 & 4 wire Ω, frequency, period, 50,000 rdgs/s, analog level trigger	Diode test, capacitance, temperature, dB measurements, dBm measurements, statistics, limit testing	LAN, USB 2.0, and GPIB standard, Web browser interface, IntuiLink software
34420A	NanoVolt/micro-Ohm meter, 7½ digit	dc voltage, 2 & 4 wire Ω, low power resistance, ratio	2 channels – ratio and difference	Standard IntuiLink software, RS-232 and GPIB interface
3458A	Reference digital multimeter, 8½ digit	dc & ac voltage, dc & ac current, 2 & 4 wire Ω, frequency & period	3 modes of true RMS, digitizing	GPIB interface

- 50,000 counts resolution on both displays
- Up to 0.025% basic DCV accuracy
- True RMS AC, AC + DC measurements
- 18 measurement functions (including frequency, capacitance, temperature, duty cycle and pulse width) and Min/Max recording
- Manual and automatic data logging with optional IR-USB cable
- Built-in battery charging
- Programmable square wave generator (U1252A only)
- 20 MHz frequency counter (U1252A only)



The high performance Agilent U1250A Series handheld digital multimeters (DMMs) bring high performance on-the-go for electronic troubleshooting and validation. Owing to its innovation and credibility, it has been named an EDN Hot 100 Product of 2006 and analogZone Best Value Portable Test Equipment of 2006.

Feature-rich, Value Handheld DMM

The U1250A Series comes with multiple functions in one instrument, including DMM, frequency counter, temperature measurement and square wave output functions. It provides high performance features including true RMS and up to 0.025% accuracy, so you can detect failures and troubleshoot fast. The U1250A Series also comes with calibration certification, GUI data logging software and essential tools for your test needs, so you can get started on your tasks sooner and at no extra cost.

Sort Out Failures and Root Cause Fast

The U1250A Series offers up to 0.025% accuracy, and true RMS AC and AC+DC readings. With its backlit, 50,000 count dual display, you can view simultaneous measurements clearly on the front panel. The U1250A Series offers various math functions such as Min/Max recording, so you can manipulate your measurement results. Use the programmable square wave generator function in the U1252A to stimulate electronic circuits while you debug.

Detect Intermittent Failures Easily

Perform your measurements fast at 7 readings/s. The U1250A Series includes a GUI data logging software so you can automate data logging to PC via the optional IR-USB cable. The software is easy to use and setup with USB.

Make Field Measurements with Assurance

Use the U1250A Series with confidence in almost any environment. The U1250A Series is built in a robust package with shock absorbing overmold and operates within rated temperature specifications of -20°C to 55°C. With a rating of CAT III 1000 V, you have the confidence to carry out measurements on electrical installations in buildings, even if the equipment is connected to the mains circuit.

Specifications

Features	U1251A	U1252A
Display	Dual display	Dual display
Resolution	50,000 counts	50,000 counts
Auto Ranging	Yes	Yes
Manual Ranging	Yes	Yes
True RMS	AC	AC + DC
DC Voltage		
Range	1000 V	1000 V
Accuracy	0.03% + 5 counts	0.025% + 5 counts
DC Current		
Range	10 A	10 A
Accuracy	0.1% + 5 counts	0.05% + 5 counts
Resistance		
Range	500 MΩ	500 MΩ
Accuracy	0.08% + 5 counts	0.05% + 5 counts
AC Voltage		
Range	1000 V	1000 A
Accuracy	0.6% + 25 counts	0.4% + 25 counts
AC Current		
Range	10 A	10 A
Accuracy	0.8% + 20 counts	0.7% + 20 counts
Frequency		
Range	1 MHz	20 MHz
Accuracy	0.02% + 3 counts	0.02% + 3 counts
Temperature		
Thermocouple Type	K	J, K
Accuracy	0.3% + 3°C	0.3% + 3°C
Capacitance		
Range	10 nF – 100 mF	10 nF – 100 mF
Accuracy	1% + 5 counts	1% + 5 counts
Conductance	Yes	Yes
Continuity with Beeper	Yes	Yes
Diode Test	Yes	Yes
Square Wave Output	—	Hz, % selectable
Duty Cycle/Pulse Width	Yes	Yes
dB	Yes	Yes
NULL	Yes	Yes
Min/Max Recording	Yes	Yes
Display Hold	Yes	Yes
Reading Memory	100	100
Automatic and Manual Data Logging	Yes	Yes
Interface	IR-USB	IR-USB
Analog Bargraph	Yes	Yes
Backlighting	Blue LED	Blue LED
Battery	9 V battery	Ni-MH rechargeable battery

Note: Accuracy specifications are best accuracy based on 30 minutes warm up time.

General Specifications

Display

Both primary and secondary displays are 5 digit on the LCD display. Both the primary and secondary displays offer a maximum resolution of 50,000 counts. Automatic polarity indication.

Power Consumption

- 105 mVA/420 mVA (with backlit) maximum (U1251A)
- 165 mVA/480 mVA (with backlit) maximum (U1252A)

Operating Environment

- Full accuracy at –20°C to 55°C
- Full accuracy to 80% RH for temperature up to 35 °C, decreasing linearly to 50% RH at 55 °C

Altitude

- 0 – 2000 meters per IEC 61010-1 2nd Edition CAT III, 1000 V
- 2000 – 3000 meters per IEC 61010-1 2nd Edition CAT III, 600 V

Storage Compliance

–40°C to 70°C

Safety Compliance

Certified by CSA for IEC/EN/CSA/UL 61010-1 2nd Edition and CAN/CSA 22.2 61010-1 2nd Edition

Measurement Category

CAT III 1000 V Overvoltage Protection up to 2000 m, Pollution degree 2

EMC Compliance

Certified to IEC/EN 61326: 2002, CISPR 11, and equivalents for Group 1, Class A

Common Mode Rejection Ratio (CMRR)

>90 dB at DC, 50/60 Hz + 0.1% (1 kΩ unbalanced)

Normal Mode Rejection Ratio (NMRR)

>60 dB at DC, 50/60 Hz + 0.1%

Temperature Coefficient

0.15 * (specified accuracy)/°C (from 20°C to 18°C or 28°C to 55°C)

Shock and Vibration

Tested to IEC/EN 60068-2

Dimension

203.5 mm (W) x 94.4 mm (D) x 59.0 mm (H)

Weight

- 504 ± 5 g with battery (U1251A)
- 527 ± 5 g with battery (U1252A)

Charging Time (only U1252A)

<220 minutes approx. at the environment of 10°C to 30°C

Warranty

3-year factory warranty

Key Literature & Web Link

Data sheet, p/n 5989-5509EN

Brochure, p/n 5989-6381EN

For more information on U1250A Series www.agilent.com/find/U1250A

To watch U1250A Series interactive product showcase

www.agilent.com/find/U1250A_showcase

Ordering Information

U1251A Handheld Digital Multimeter

U1252A Handheld Digital Multimeter

Includes soft carrying case, alkaline 9 V battery (U1251A only), rechargeable Ni-MH battery with power adapter (U1252A only), U1160A Standard Test Lead Kit, Product Reference CD (includes the User's and Service Guide, GUI datalogger software and instrument drivers), Quick Start Guide, Certificate of Calibration (CoC) and test report

Accessories

U1160A Standard Test Lead Kit (includes SMT grabbers, a mini grabber, standard test leads, alligator clips and fine tip test probes)

U1161A Extension Test Lead Kit

U1173A IR-to-USB Cable

U1180A Thermocouple Lead Kit

34132A Deluxe Test Lead Kits

34133A Precision Electronics Test Leads

- 120,000 count resolution
- 16 measurement functions including temperature and capacitance
- 6 built-in math functions: Null, dBm, dB, MinMax, Limit and Hold
- Up to 70 readings/s
- 0.025% DC voltage accuracy
- USB 2.0 interface (TMC-488.2-compliant)
- SCPI-compatible
- Data logging capability with DMM IntuiLink connectivity software



Affordable and Feature-rich

The 34405A provides a broad range of features and measurement functions despite its value price, including DC voltage, DC current, true-RMS AC voltage and AC current, 2-wire resistance, frequency, diode test, continuity, temperature (–80°C to 150°C) and capacitance (1000 pF to 10,000 µF). Six built-in math operations are available for efficient, accurate results: Null, dBm, dB, MinMax, Limit and Hold.

Make Measurements Fast

Set up your instrument fast with 34405A's plug-and-play USB interface, and auto-detection by the bundled, award-winning Agilent IO Libraries Suite. The 34405A comes with a dual display feature that allows simultaneous display of two measurements on the front panel. Its fast reading speed of 70 readings/s allows you to detect intermittent failures and anomalies easily. With 34405A's store/recall function, you can configure and store complete instrument setups and load them at anytime from any of the four built-in storing states.

Remote Control and Data Logging via PC

You can use the bundled DMM IntuiLink Connectivity software for instrument control, configuration and data logging to PC via USB. The 34405A can also be controlled remotely with industry-standard SCPI commands. For its easy integration into different programming environments, the 34405A is shipped with the Agilent IO Library Suite, LabVIEW driver and IVI-COM driver.

Specifications

DC Specifications¹

Function	Range ²	Test Current or Burden Voltage	Input Impedance ³	Accuracy ± (% of reading + % of range)	
				1 Year 23°C ± 5°C	Temperature Coefficient 0°C – 18°C 28°C – 55°C
Voltage	100.000 mV	—	10.0 MΩ ± 2%	0.025 + 0.008	0.0015 + 0.0005
	1.00000 V	—	10.0 MΩ ± 2%	0.025 + 0.006	0.0010 + 0.0005
	10.0000 V	—	10.1 MΩ ± 2%	0.025 + 0.005	0.0020 + 0.0005
	100.000 V	—	10.1 MΩ ± 2%	0.025 + 0.005	0.0020 + 0.0005
	1000.00 V	—	10.0 MΩ ± 2%	0.025 + 0.005	0.0015 + 0.0005
Resistance	100.000 Ω	1.0 mA	—	0.05 + 0.008 ⁴	0.0060 + 0.0008
	1.00000 kΩ	0.83 mA	—	0.05 + 0.005 ⁴	0.0060 + 0.0005
	10.0000 kΩ	100 µA	—	0.05 + 0.006 ⁴	0.0060 + 0.0005
	100.000 kΩ	10.0 µA	—	0.05 + 0.007	0.0060 + 0.0005
	1.00000 MΩ	900 nA	—	0.06 + 0.007	0.0060 + 0.0005
	10.0000 MΩ	205 nA	—	0.25 + 0.005	0.0250 + 0.0005
	100.000 MΩ	205 nA 10 MΩ	—	2.00 + 0.005	0.3000 + 0.0005
Current	10.0000 mA	<0.2 V	—	0.05 + 0.015	0.0055 + 0.0005
	100.000 mA	<0.2 V	—	0.05 + 0.005	0.0055 + 0.0005
	1.00000 A	<0.5 V	—	0.20 + 0.007	0.0100 + 0.0005
	10.0000 A	<0.6 V	—	0.25 + 0.007	0.0150 + 0.0005
Continuity	1000 Ω	0.83 mA	—	0.05 + 0.005	0.0050 + 0.0005
Diode Test ⁵	1.0000 V	0.83 mA	—	0.05 + 0.005	0.0050 + 0.0005

¹ Specifications are for 30 minutes warm-up, 5½ digit resolution and calibration temperature 18°C – 28°C.

² 20% over range on all ranges except 1000 Vdc.

³ Input Impedance is in parallel with capacitance <120 pF.

⁴ Specifications are 2-wire ohms using Math Null. If without Math Null, add 0.2 Ω additional error.

⁵ Specifications are for the voltage measured at the input terminals only.

Digital Multimeters

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5½ Digit Dual Display Digital Multimeter (cont.)

AC Specifications¹

Function	Range ²	Frequency	Accuracy ± (% of reading + % of range)		
			1 Year 23°C ± 5°C	Temperature Coefficient 0°C – 18°C 28°C – 55°C	
True-RMS AC Voltage ³	100.000 mV	20 Hz – 45 Hz	1.0 + 0.1	0.02 + 0.02	
		45 Hz – 10 kHz	0.2 + 0.1	0.02 + 0.02	
		10 kHz – 30 kHz	1.5 + 0.3	0.05 + 0.02	
		30 kHz – 100 kHz ⁴	5.0 + 0.3	0.10 + 0.02	
	1.00000 V to 750.00 V	20 Hz – 45 Hz	1.0 + 0.1 ⁵	0.02 + 0.02	
		45 Hz – 10 kHz	0.2 + 0.1	0.02 + 0.02	
		10 kHz – 30 kHz	1.0 + 0.1	0.05 + 0.02	
		30 kHz – 100 kHz ⁴	3.0 + 0.2 ⁶	0.10 + 0.02	
True-RMS AC Current ⁷	10.0000 mA	20 Hz – 45 Hz	1.5 + 0.1	0.02 + 0.02	
	100.000 mA	45 Hz – 1 kHz	0.5 + 0.1	0.02 + 0.02	
	10.0000 A	1 kHz – 10 kHz ⁸	2.0 + 0.2	0.02 + 0.02	
Frequency ⁹	100 mV to 750 V	<2 Hz	0.18 + 0.003	0.005	
		<20 Hz	0.04 + 0.003	0.005	
		20 Hz – 100 kHz ¹⁰	0.02 + 0.003	0.005	
		100 kHz – 300 kHz ¹¹	0.02 + 0.003	0.005	
	10 mA to 10 A	<2 Hz	0.18 + 0.003	0.005	
		<20 Hz	0.04 + 0.003	0.005	
		20 Hz – 10 kHz ¹⁰	0.02 + 0.003	0.005	

Temperature and Capacitance Specifications¹

Function	Range	Test Current, etc.	Accuracy ± (% of reading + % of range)	
			1 Year 23°C ± 5°C	Temperature Coefficient 0°C – 18°C 28°C – 55°C
Temperature	–80°C – 150°C	5 kΩ Thermistor Probe	Probe Accuracy + 0.2°C	0.002°C
	–110.0°F – 300.0°F	5 kΩ Thermistor Probe	Probe Accuracy + 0.4°F	0.0036°F
Capacitance	1.000 nF	0.75 µA	2.0 + 0.8	0.02 + 0.001
	10.00 nF	0.75 µA	1.0 + 0.5	0.02 + 0.001
	100.0 nF	8.3 µA	1.0 + 0.5	0.02 + 0.001
	1.000 µF – 100.0 µF	83 µA	1.0 + 0.5	0.02 + 0.001
	1000 µF	0.83 mA	1.0 + 0.5	0.02 + 0.001
	10,000 µF	0.83 mA	2.0 + 0.5	0.02 + 0.001

¹ Specifications are for 30 minutes warm-up, 5½ digit resolution and calibration temperature 18°C – 28°C.

² 20% over range on all range except 750 Vac.

³ Specifications are for sine wave inputs >5% of range. Maximum crest factor : 3 at full scale.

⁴ Additional error to be added as frequency >30 kHz and signal input <10% of range. 30 kHz – 100 kHz: 0.003% of full scale per kHz.

⁵ For input <200 V rms.

⁶ For input <300 V rms.

⁷ For 12 A terminal, 10 A dc or ac rms continuous, >10 A dc or ac rms for 30 seconds ON and 30 seconds OFF.

⁸ For 1 A and 10 A ranges, the frequency is verified for less than 5 kHz.

⁹ Specifications are for half-hour warm-up, using 0.1 second aperture. The frequency can be measured up 1 Mhz as 0.5 V signal to 100 mV/1 V ranges.

¹⁰ For 20 Hz – 10 kHz, the sensitivity is AC input current from 10% to 120% of range except where noted.

¹¹ For 100 Hz – 300 kHz, the sensitivity will be 12% – 120% of range except 750 V range.

Operating Specifications

Function	Digits	Reading Speed ¹	System Speed			
			Function Change (sec) ²	Range Change (sec) ³	Auto Range (sec) ⁴	Reading Speed Over USB ⁵
DCV, DCI	5½	15/s	0.6	0.7	2.2	8/s
	4½	70/s	0.6	0.7	2.2	19/s
ACV, ACI	5½	2.5/s	5.0	2.2	6.1	1/s
	4½	2.5/s	5.0	2.2	6.1	1/s
Frequency⁶	5½	9/s	7.0	2.5	6.1	1/s
	4½	9/s	7.0	2.5	6.1	1/s

¹ Reading rate of the A/D converter.² Time to change from 2-wire resistance to this specified functions and to take at least one reading in 4.5 digit using the SCPI "FUNC" and "READ?" commands.³ Time to change one range to the next higher range and to take at least one reading in 4.5 digit using the SCPI "FUNC" and "READ?" commands.⁴ Time to automatically change one range and to take at least one reading in 4.5 digit using SCPI "CONF AUTO" and "READ?" commands.⁵ Number of measurements per second that can be read through USB using SCPI "READ?" command.⁶ Reading rate depend on signal frequency >10 Hz.

Supplemental Measurement Specifications

Math Functions

Null, dBm, dB, Min/Max/Avg, Hold, Limit Test

Remote Interface

USB 2.0 full speed, USBTMC class device (GPIB over USB)

Programming Language

SCPI, IEEE-488.1, IEEE-488.2

General Specifications

Weight

3.75 kg, 8.27 lb

Dimension

Rack: 88.5 mm (H) x 212.6 mm (W) x 272.3 mm (D)

Bench: 103.8 mm (H) x 261.2 mm (W) x 303.2 mm (D)

Safety Compliance

Certified to CSA for IEC/EN/CSA/UL 61010-1 2nd Edition

Warranty

1 year

Ordering Information

34405A Digital Multimeter

Includes power cord, USB interface cable, Test Lead Kit, Product Reference CD-ROM (includes DMM IntuiLink connectivity software, and IVI-COM and LabVIEW drivers) Agilent IO Library Suite CD-ROM, Certificate of Calibration (CoC), test report, Quick Start Guide in multiple languages, User's and Service Guide

Accessories

34405A-1CM Rack Mount Adapter Kit

34405A-A6J ANSI/NCSS Z540 Compliance Calibration

34132A Deluxe Test Lead Kits

34330A 30 A Current Shunt

34133A Precision Electronics Test Leads

E2308A Thermistor Probe

Key Literature & Web Link

Data Sheet, p/n 5989-4906EN

Easy Steps to Integrate the 34405A Multimeter into a System Application

Note, p/n 5989-5980EN

Side-by-Side Comparison: Agilent 34405A and Fluke 45 Digital Multimeter

Application Note, p/n 5989-5979EN

Migration from the Agilent 34401A to the Agilent 34405A Digital

Multimeter Application Note, p/n 5989-5515EN

For more information on 34405A: www.agilent.com/find/34405AFor driver and software downloads: <http://adn.tm.agilent.com/>

34401A

- 12 measurement functions
- 1000 V maximum input
- 15 ppm basic dcV accuracy (24-hour)
- 1000 readings per second direct to GPIB

- GPIB and RS-232 standard
- 512-reading memory
- SCPI commands standard
- IntuiLink Connectivity Software included



34401A

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34401A Digital Multimeter

The 34401A digital multimeter establishes a new price/performance standard by offering such features as 6½ digits of resolution, 1000 readings per second, and 15 ppm basic dc accuracy at a surprisingly affordable price. The 34401A has been designed for superior performance while providing the flexibility to meet both your present and future needs.

Great Bench Performance

The clear, logical front panel of the 34401A allows you to easily select all primary measurement functions. Traditional “bench” functions, such as continuity and diode test, are included. Math functions, such as NULL, dB, dBm, limit test, and min/max/avg are easily selected. A simple menu scheme gives you access to powerful advanced features, such as the ability to store up to 512 readings in internal memory. Measurement results are displayed on a bright, high-visibility readout. A rugged case ensures survival even under the toughest conditions, and the optional accessory pouch makes it easy to pack up and go with the 34401A.

Superior Performance in Your System

The 34401A can take up to 1000 readings per second, including GPIB bus transfer in ASCII format. Both GPIB and RS-232 are standard, letting you select the interface that best meets your needs. The 34401A responds to three different command languages. It accepts SCPI commands (Standard Commands for Programmable Instruments), which ensures present and future compatibility. Drivers are also available for both National Instruments Labview and Agilent's VEE software.

IntuiLink Software, included with your 34401A, allows you to transfer your measurement data and images into Microsoft Excel or Microsoft Word with little or no programming. You can specify the meter setup and take a single reading or log data to the Excel spreadsheet in specific time intervals. Programmers can use the ActiveX components to control the DMM using SCPI commands. To find out more about IntuiLink, visit www.agilent.com/find/intuilink

Abbreviated Technical Specifications

DC Voltage

Input Characteristics

Range	Maximum Reading (6½ digits)	Resolution in Digits			Input Resistance
		6½	5½	4½	
100 mV	120.0000	100 nV	1 µV	10 µV	10 MΩ or >10 GΩ
1 V	1.200000	1 µV	10 µV	100 µV	10 MΩ or >10 GΩ
10 V	12.00000	10 µV	100 µV	1 mV	10 MΩ or >10 GΩ
100 V	120.0000	100 µV	1 mV	10 mV	10 MΩ
1000 V	1050.000	1 mV	10 mV	100 mV	10 MΩ

Input Protection: >1000 V on all ranges

Measurement Accuracy: ±(% of reading + % of range)

Range	24-Hour 23°C ± 1°C	90-Day 23°C ± 5°C	1-Year 23°C ± 5°C
100 mV	0.0030 + 0.0030	0.0040 + 0.0035	0.0050 + 0.0035
1 V	0.0020 + 0.0006	0.0030 + 0.0007	0.0040 + 0.0007
10 V	0.0015 + 0.0004	0.0020 + 0.0005	0.0035 + 0.0005
100 V	0.0020 + 0.0006	0.0035 + 0.0006	0.0045 + 0.0006
1000 V	0.0020 + 0.0006	0.0035 + 0.0010	0.0045 + 0.0010

Noise Rejection: (50 or 60 Hz, 1 kΩ unbalance in LO lead)

DC CMRR: 140 dB

AC CMRR: 70 dB

Normal Mode Rejection (60 Hz/50 Hz) ± 0.1%:

100 PLC (1.67 s/2.00 s): 60 dB

10 PLC (167 ms/200 ms): 60 dB

1 PLC (16.7 ms/20.0 ms): 60 dB

<1 PLC (3 ms or 800 µs): 0 dB

Maximum Reading Rate: (readings/s)

Power Line Frequency	Resolution in Digits		
	6½	5½	4½
60 Hz	6	300	1000
50 Hz	5	300	1000

AC Voltage (true rms)**Measurement Accuracy:** \pm (% of reading + % of range); 1 year, 23°C \pm 5°C

Frequency	Ranges 100 mV	Ranges 1, 10, 100, 750 V
3 to 5 Hz	1.00 + 0.04	1.00 + 0.03
5 to 10 Hz	0.35 + 0.04	0.35 + 0.03
10 Hz to 20 kHz	0.06 + 0.04	0.06 + 0.03
20 to 50 kHz	0.12 + 0.04	0.12 + 0.05
50 to 100 kHz	0.60 + 0.08	0.60 + 0.08
100 to 300 kHz	4.00 + 0.50	4.00 + 0.50

Note: -3 dB frequency typically >1 MHz

Input Resistance: 1 M Ω \pm 2%, in parallel with 100 pF**Input Protection:** >750 V rms on all ranges**Maximum Volt-Hz Product:** 8 \times 10⁷**Crest Factor:** Maximum of 5:1 at full scale**Maximum Reading Rate:** 10 readings/s (50 readings/s with default delays defeated)**Frequency and Period****Range:** 3 Hz to 300 kHz (333 ms to 3.33 μ s)**1-Year Accuracy:** 0.01% (40 Hz to 300 kHz); 0.05% (3 to 40 Hz)**Resolution:** 10 μ Hz to 1 Hz**Other Measurement Functions:** Continuity, Diode Test, Ratio dc:dc, Limit Test**Math Functions:** NULL, Min/Max/Avg, dB, dBm, Limit Test**Memory:** 512-reading internal storage**Standard Programming Languages:** SCPI, Agilent 3478A and Fluke 8840A/42A**Computer Interface:** GPIB and RS-232C standard**Accessories Included:** Test lead kit, operators manual, service manual, test report, and power cord**Resistance:** (2-wire Ω , 4-wire Ω)**Input Characteristics**

Range	Maximum Reading (6½ digits)	Resolution in Digits		
		6½	5½	4½
100 Ω	120.0000	100 $\mu\Omega$	1 m Ω	10 m Ω
1 k Ω	1.200000	1 m Ω	10 m Ω	100 m Ω
10 k Ω	12.00000	10 m Ω	100 m Ω	1 Ω
100 k Ω	120.0000	100 m Ω	1 Ω	10 Ω
1 M Ω	1.200000	1 Ω	10 Ω	100 Ω
10 M Ω	12.00000	10 Ω	100 Ω	1 k Ω
100 M Ω	120.0000	100 Ω	1 k Ω	10 k Ω

Input Protection: >1000 V on all ranges**Measurement Accuracy:** \pm (% of reading + % of range)Specs are for 4-wire Ω or 2-wire Ω using Math Null

Range	24-Hour 23°C \pm 1°C	90-Day 23°C \pm 5°C	1-Year 23°C \pm 5°C	Current Source
100 Ω	0.0030 + 0.0030	0.008 + 0.004	0.010 + 0.004	1 mA
1 k Ω	0.0020 + 0.0005	0.008 + 0.001	0.010 + 0.001	1 mA
10 k Ω	0.0020 + 0.0005	0.008 + 0.001	0.010 + 0.001	100 μ A
100 k Ω	0.0020 + 0.0005	0.008 + 0.001	0.010 + 0.001	10 μ A
1 M Ω	0.0020 + 0.001	0.008 + 0.001	0.010 + 0.001	5.0 μ A
10 M Ω	0.0150 + 0.001	0.020 + 0.001	0.040 + 0.001	500 nA
100 M Ω	0.3000 + 0.010	0.800 + 0.010	0.800 + 0.010	500 nA*

* Measurement is computed from 10 M Ω in parallel with input.**Maximum Reading Rate:** Same as dcV**DC Current****Measurement Accuracy:** \pm (% of reading + % of range)

Range	24-Hour 23°C \pm 1°C	90-Day 23°C \pm 5°C	1-Year 23°C \pm 5°C	Shunt Resistance
10 mA	0.005 + 0.010	0.030 + 0.020	0.050 + 0.020	5.0 Ω
100 mA	0.010 + 0.004	0.030 + 0.005	0.050 + 0.005	5.0 Ω
1 A	0.050 + 0.006	0.080 + 0.010	0.100 + 0.010	0.1 Ω
3 A	0.100 + 0.020	0.120 + 0.020	0.120 + 0.020	0.1 Ω

Burden Voltage: <2 V for 3 A input; <0.1 V for 10 mA input**Input Protection:** Externally accessible 3 A 250 V fuse; internal 7 A 500 V fuse**Maximum Reading Rate:** Same as dcV**AC Current** (true rms)**Measurement Accuracy:** \pm (% of reading + % of range); 1 year, 23°C \pm 5°C

Frequency	Ranges 1 A	Ranges 3 A
3 to 5 Hz	1.00 + 0.04	1.10 + 0.06
5 to 10 Hz	0.30 + 0.04	0.35 + 0.06
10 Hz to 5 kHz	0.10 + 0.04	0.15 + 0.06

Burden Voltage: <1.5 V rms for 3 A input**Input Protection:** Externally accessible 3 A 250 V fuse; internal 7 A 500 V fuse**Maximum Reading Rate:** Same as acV**General Specifications****Power:** 100/120/220/240V, \pm 10%**Power Line Frequency:** 45 to 66 Hz, 360 to 440 Hz**Power Consumption:** 25 VA peak (10 W average)**Operating Environment:** 0 to 55°C, full accuracy to 80% RH, 40°C**Storage Environment:** -40°C to 75°C**Size:** 88.5 mm H x 212.6 mm W x 348.3 mm D (4 in x 8.5 in x 14 in)**Weight:** Net, 3.6 kg (8.0 lb); shipping, 5.9 kg (13 lb)**Safety:** Designed to UL-1244, IEC-348, CSA**Ordering Information****34401A** Multimeter**34401A-1CM** Rackmount Kit**34401A-A6J** ANSI Z540 Compliant Calibration**34161A** Accessory Pouch**34171B** Input Terminal Connector (sold in pairs)**34172B** Input Calibration Short (sold in pairs)**34131A** Hard Transit Case

Digital Multimeters

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6½ Digit Digital Multimeters

34410A

- 6½ digit resolution
- 10,000 readings/sec @ 5½ digits to the PC
- LAN, USB & GPIB standard
- Capacitance & temperature measurements
- Data logger for improved usability
- 50,000 reading non-volatile memory
- LXI class C compliant



The Agilent 34410A is a high performance digital multimeter designed for high speed and precise triggering, offering maximum versatility for present and future needs. The 34410A is a 6½ digit, dual display, benchtop and system digital multimeter featuring 10,000 readings per second at 5½ digits, datalogging, resistance and frequency, and LAN, USB and GPIB connectivity. If you need up to 50,000 readings/second, consider the 34411A 6½ Digit Enhanced Performance Digital Multimeter.

Specifications

Measurement Capability

0.0030% basic DC accuracy
Capacitance & Temperature
Data Logger with 50,000 reading non-volatile memory

System Capability

LAN (LXI class C), USB & GPIB standard
10,000 readings/sec @ 5½ digits to the PC
1,000 readings/sec @ 6½ digits to the PC

Accessories

34132B Deluxe Lead Set with Retractable Sheath
34133A Precision Electronic Test Leads
34134A DC Coupled Current Probe
34136A High Voltage Probe
34138A Test Lead Set
34171B Input Terminal Block
34172B Calibration Short
34190A Rackmount Kit
34308A Thermistor Kit
34330A 30 A Current Shunt
82350B PCI High-Performance GPIB Interface Card
E5810A LAN/GPIB Gateway

Key Literature & Web Link

www.agilent.com/find/34410A

Ordering Information

34410A 6½ Digit DMM

Stand alone order – can select standard options for repair/calibration, power cord, and manuals. Otherwise, it ships with everything you need including a CD with programming examples, drivers, Intuilink, etc.

- 6½ digit resolution
- 50,000 readings/sec. @ 4½ digits to the PC
- 1 M reading memory
- Analog level and pre/post triggering
- LAN, USB & GPIB standard
- Capacitance & temperature measurements
- Data logger for improved usability
- 50,000 reading non-volatile memory
- LXI class C compliant



The Agilent 34411A sets a new benchmark for digital multimeter performance with up to 50,000 readings per second at 4½ digits, 1 million readings of volatile memory and triggering capabilities. The 34411A has all the features of the 34410A, plus additional performance that makes it even more powerful. The 34411A Enhanced Performance 6½ digit digital multimeter can be used in R&D and manufacturing environments as a bench or system instrument.

34411A

Specifications

Measurement Capability

0.0030 % basic DC accuracy

Capacitance & Temperature

Data Logger with 50,000 reading non-volatile memory

System Capability

LAN (LXI class C), USB & GPIB standard

50,000 readings/sec @ 4½ digits to the PC

10,000 readings/sec @ 5½ digits to the PC

1,000 readings/sec @ 6½ digits to the PC

1M reading memory

Analog level and pre/post triggering

Accessories

34132B Deluxe Lead Set with Retractable Sheath

34133A Precision Electronic Test Leads

34134A DC Coupled Current Probe

34136A High Voltage Probe

34138A Test Lead Set

34171B Input Terminal Block

34172B Calibration Short

34190A Rackmount Kit

34308A Thermistor Kit

34330A 30 A Current Shunt

82350B PCI High-Performance GPIB Interface Card

E5810A LAN/GPIB Gateway

Key Literature & Web Link

www.agilent.com/find/34411A

Ordering Information

34411A 6½ Digit DMM

Can be ordered with the standard choices of repair/warranty and power cords. The instrument comes complete with programming examples and drivers on a CD.

Digital Multimeters

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6½ Digit Digital Multimeters (cont.)

L4411A

- 1 Rack Unit high
- 6½ digit resolution
- 50,000 readings/sec. @4½ digits to the PC
- 1 M reading memory
- Analog level and pre/post triggering
- LAN, USB & GPIB standard
- Capacitance & temperature measurements
- 50,000 reading non-volatile memory
- LXI class C compliant
- Compatibility mode for 34401A/E1412A



The Agilent L4411A is an enhanced performance digital multimeter with up to 50,000 readings per second at 4½ digits, 1 million readings of volatile memory and triggering capabilities in a 1 rack unit high size. With all the features of the 34411A, users can take advantage of the 34401A/E1412A compatibility mode to easily integrate this new multimeter into existing test systems. The simple display shows the user the current reading and LAN address for easy debugging. The L4411A is a 6½ digit, 1 Rack Unit tall enhanced performance digital multimeter optimized for use in manufacturing environments where space is at a premium.

Specifications

Measurement Capability

0.0030 % basic DC accuracy
Capacitance & Temperature

System Capability

LAN (LXI class C), USB & GPIB standard
50,000 readings/sec @4½ digits to the PC
10,000 readings/sec @5½ digits to the PC
1,000 readings/sec @6½ digits to the PC

1M reading memory
Analog level and pre/post triggering
1 Rack Unit tall

Accessories

34132B Deluxe Lead Set with Retractable Sheath
34133A Precision Electronic Test Leads
34134A DC Coupled Current Probe
34136A High Voltage Probe
34138A Test Lead Set
34171B Input Terminal Block
34172B Calibration Short
34190A Rackmount Kit
34308A Thermistor Kit
34330A 30 A Current Shunt
82350B PCI High-Performance GPIB Interface Card
E5810A LAN/GPIB Gateway

Key Literature & Web Link

www.agilent.com/find/L4411A

Ordering Information

L4411A 6½ Digit DMM

Can be ordered with the standard choices of repair/warranty and power cords. The instrument comes complete with programming examples and drivers on a CD.

- 1.3 nV rms noise/8 nVp-p
- 100 pV, 100 nΩ sensitivity
- Two-channel programmable voltage input; difference and ratio functions
- 7½ digit resolution
- 1 mV to 100 V ranges
- SCPI and Keithley 181 languages
- Direct SPRT, RTD, Thermistor, and thermocouple temperature measurements
- IntuiLink Connectivity Software included



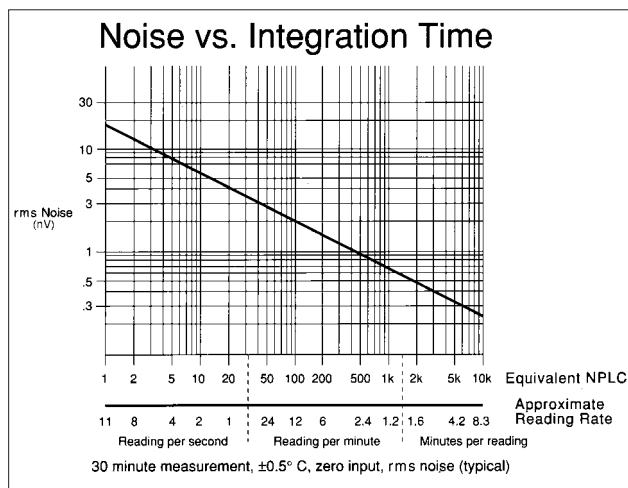
34420A

34420A Nanovolt/Micro-ohm Meter

The Agilent 34420A sets a price/performance standard in low-level measurement capability. The noise performance of the 34420A nanovolt/micro-ohm meter is more than an order of magnitude better than that previously available from Hewlett-Packard.

Accurate, Repeatable Low-Level Measurements

A shielded copper pin screw-down connector, a 7½-digit A/D converter, 2 ppm basic dc accuracy, and a new measurement algorithm that gives 100 dB normal mode rejection without front-end filtering result in measurement capability you can depend on to make accurate and repeatable low-level measurements. Low noise input amplifiers and a highly-tuned input protection scheme bring reading noise down to 8 nVp-p. Longer integration times improve noise performance even further.



Unprecedented Functionality

Two input channels allow voltage measurements to be made independently, or they can be mathematically combined to make difference and ratio measurements. Ohms measurements combine the low-noise input circuits with a highly-stable current source to provide outstanding low-resistance measurements. Offset compensation is employed to eliminate the effects of stray thermal EMFs that would otherwise result in measurement error. Low power ohms and a low-voltage resistance measurement capability allow repeatable measurements to be made where a low voltage (20 mV) is required to avoid oxidation punch-through. A wide range of temperature measurement capabilities are also built in, providing support for SPRT, thermocouple, RTD, and thermistor temperature sensors.

Math Functions Enhance Capabilities

Math functions such as NULL, STATS, and SCALE ease the capture of minimum and maximum readings, provide averages and standard deviation, scale your measurement results, and ultimately makes it easier for you to characterize your input signal. The 34420A can also store up to 1024 readings in internal memory.

Built-in Versatility

You will find that the 34420A will fit equally well into your bench or your system applications. Designed with the bench user in mind, operation of the 34420A from the front panel is straightforward and intuitive. For system applications, the 34420A includes both GPIB and RS-232 interfaces standard, and uses Standard Commands for Programmable Instrumentation (SCPI). This ensures both present and future compatibility. The 34420A also responds to commands for the Keithley 181 nanovoltmeter.

Agilent IntuiLink: Easy Data Access

The Included Agilent IntuiLink software allows your captured data to be put to work easily, using PC applications such as Microsoft Excel or Microsoft Word, to analyze, interpret, display, print, and document the data you get from the 34420A. To find out more about IntuiLink, visit www.agilent.com/find/intuilink

Abbreviated Technical Specifications

Accuracy Specifications: \pm (% of reading + % of range)

DC Voltage¹ – 7½ digits Resolution all Ranges

Range	24-Hour 23°C ± 1°C	90-Day 23°C ± 5°C	1-Year 23°C ± 5°C
1 mV	0.0025 + 0.0020	0.0040 + 0.0020	0.0050 + 0.0020
10 mV	0.0025 + 0.0002	0.0040 + 0.0002	0.0050 + 0.0003
100 mV	0.0015 + 0.0003	0.0030 + 0.0004	0.0040 + 0.0004
1 V	0.0010 + 0.0003	0.0025 + 0.0004	0.0035 + 0.0004
10 V	0.0002 + 0.0001	0.0020 + 0.0004	0.0030 + 0.0004
100 V	0.0010 + 0.0004	0.0025 + 0.0005	0.0035 + 0.0005

DCV1/DCV2 (ratio): Ratio error in % = channel 1 accuracy in % + channel 2 accuracy in %

DCV1-2 (difference): Difference error = channel 1 (% reading + % range) + channel 2 (% reading + % range)

DC Voltage Noise Specifications²

Range	2-Minute rms Noise	2-Minute p-p Noise	24-Hour p-p Noise
1 mV	1.3 nV RMS	8 nV p-p	12 nV p-p
10 mV	1.5 nV RMS	10 nV p-p	14 nV p-p
100 mV	10 nV RMS	65 nV p-p	80 nV p-p
1 V	100 nV RMS	650 nV p-p	800 nV p-p
10 V	450 nV RMS	3 μ V p-p	3.7 μ V p-p
100 V	11 μ V RMS	75 μ V p-p	90 μ V p-p

DC Voltage

- Input Resistance:
 - 10 M Ω \pm 1% (100 V range)
 - >10 G Ω (1 mV through 10 V range)
- Input Protection:
 - 150 V peak to Channel 1 LO

Resistance³ – 7½ digits Resolution all Ranges

Range	Test Current	24-Hour 23°C ± 1°C	90-Day 23°C ± 5°C	1-Year 23°C ± 5°C
1 Ω	10 mA	0.0015 + 0.0002	0.0050 + 0.0002	0.0070 + 0.0002
10 Ω	10 mA	0.0015 + 0.0002	0.0040 + 0.0002	0.0060 + 0.0002
100 Ω	10 mA	0.0015 + 0.0002	0.0040 + 0.0002	0.0060 + 0.0002
1 k Ω	1 mA	0.0015 + 0.0002	0.0040 + 0.0002	0.0060 + 0.0002
10 k Ω	100 μ A	0.0015 + 0.0002	0.0040 + 0.0002	0.0060 + 0.0002
100 k Ω	10 μ A	0.0015 + 0.0003	0.0040 + 0.0004	0.0060 + 0.0004
1 M Ω	5 μ A	0.0020 + 0.0003	0.0050 + 0.0004	0.0070 + 0.0004

Low Power Resistance³

Range	Test Current	24-Hour 23°C ± 1°C	90-Day 23°C ± 5°C	1-Year 23°C ± 5°C
1 Ω	10 mA	0.0015 + 0.0002	0.0050 + 0.0002	0.0070 + 0.0002
10 Ω	10 mA	0.0015 + 0.0002	0.0040 + 0.0002	0.0060 + 0.0002
100 Ω	1 mA	0.0015 + 0.0002	0.0040 + 0.0002	0.0060 + 0.0002
1 k Ω	100 μ A	0.0015 + 0.0002	0.0040 + 0.0002	0.0060 + 0.0002
10 k Ω	10 μ A	0.0015 + 0.0004	0.0040 + 0.0004	0.0060 + 0.0004
100 k Ω	5 μ A	0.0015 + 0.0012	0.0040 + 0.0015	0.0060 + 0.0015
1 M Ω	5 μ A	0.0020 + 0.0003	0.0050 + 0.0004	0.0070 + 0.0004

Voltage Limited Resistance³

Voltage limit selectable: 20 mV, 100 mV, or 500 mV

Range	Test Current	24-Hour 23°C ± 1°C	90-Day 23°C ± 5°C	1-Year 23°C ± 5°C
10 Ω	1 mA	0.0020 + 0.0002	0.0050 + 0.0002	0.0070 + 0.0002
100 Ω	100 μ A	0.0025 + 0.0002	0.0050 + 0.0002	0.0070 + 0.0002

Temperature – 0.001°C Resolution

Probe Type	Accuracy
SPRT ⁴	SPRT probe accuracy +0.003°C
RTD	RTD probe accuracy +0.05°C
Thermistor	Thermistor probe accuracy +0.1°C
Thermocouple ⁵	Thermocouple probe accuracy +0.2°C

Temperature

SPRT: ITS-90 calibrated temperature within the range of –190°C to +660°C
RTD: Type α = 0.00385 and α = 0.00392. R_0 from 4.9 Ω to 2.1 K Ω . ITS-90 (IEC 751) Callendar – Van Dusen conversion

Thermistor: 5 K Ω

Thermocouple: ITS-90 conversions of type B, E, J, K, N, R, S, T

Chart Out (Analog Out)

Resolution: 16 bits

Maximum Output: \pm 3 V

Span and Offset: Adjustable

Filter (Analog or Digital or Both)

Analog: Low pass 2 pole @13 Hz, available for dcV on 1 mV, 10 mV, 100 mV ranges

Digital: Moving average filter. 10 (fast), 50 (medium) or 100 (slow) reading averages

Math Functions

NULL (Channel 1 dcV, Channel 2 dcV, Difference, Resistance, Temperature)

STATS (Min/max/avg, peak-peak, standard deviation, number of readings)

SCALE (Allows linear scaling as $Y=MX+B$)

CHART NULL (Establishes zero for rear-panel output)

General Specifications

Front-Panel Connection: Shielded, low-thermal, copper contacts

Interface: GPIB and RS-232 standard

Languages: SCPI-1994 (IEEE-488.2), Keithley 181

Ordering Information

34420A Nanovolt/Micro-Ohm Meter

Includes low-thermal input cable (34102A), low-thermal shorting plug (34103A), operating and service manuals, quick reference guide, test report with calibration sticker, 2.3 ml bottle of contact cleaner, and power cord.

34420A-1CM Rackmount Kit

34420A-A6J ANSI Z540 Compliant Calibration

Accessories

34102A Low-Thermal Input Cable (four-conductor with copper spade lugs)

34103A Low-Thermal Shorting Plug

34104A Low-Thermal Input Connector

34161A Accessory Pouch

34131A Hard Transit Case

¹ Specifications are for channel 1 or channel 2 (100 V range on channel 1 only), after 2-hour warm-up, resolution at 7.5 digits (100 NPLC), with filters off.

² After a 2-hour warm-up \pm 1°C, 6.5 digits (10 NPLC) with analog filter off digital filter medium (50 readings). 2 minute rms and 24-hour noise typical.

³ All resistance specifications are for channel 1 only, after 2-hour warm-up, resolution at 7.5 digits (100 NPLC) with filters off, for 4-wire Ω or 2-wire Ω using Null.

⁴ For 25 Ω SPRT with triple-point of water check within last 4 hours. With no triple-point of water check, add 0.013°C for 24-hour, 0.035°C for 90-day, and 0.055°C for 1-year specifications.

⁵ For fixed reference junction. Add 0.3°C for external reference junction, add 2.0°C for internal reference junction.



3458A

3458A Multimeter

The Agilent 3458A multimeter shatters long-standing performance barriers of speed and accuracy on the production test floor, in research and development, and in the calibration lab. The 3458A is the fastest, most flexible, and most accurate multimeter offered by Agilent Technologies. In your system or on the bench, the 3458A saves you time and money with unprecedented test-system throughput and accuracy, seven-function measurement flexibility, and low cost of ownership.

Select a rate of 100,000 reading per second for maximal test throughput. Or achieve highest levels of precision with up to 8½ digits of measurement resolution and 0.1 part per million transfer accuracy. Add to this the 3458A's simplicity of operation, and you have the ideal multimeter for your most demanding applications.

High-Test System Throughput

Faster Testing

- Up to 100,000 readings/s
- Internal test setups >340/s
- Programmable integration times from 500 ns to 1 s

Greater Test Yield

- More accuracy for tighter test margins
- Up to 8½ digits resolution

Longer Uptime

- Two-source (10 V, 10 kΩ) calibration, including ac
- Self-adjusting, self-verifying auto-calibration for all functions and ranges, including ac

High-Resolution Digitizing

Greater Waveform Resolution and Accuracy

- 16 to 24-bits resolution
- 100,000 to 0.2 sample/s
- 12 MHz bandwidth
- Timing resolution to 10 ns
- Less than 100 ps time jitter
- Over 75,000 reading internal memory

Calibration Lab Precision

Superb Transfer Measurements

- 8½ digits resolution
- 0.1 ppm dc volts linearity
- 0.1 ppm dc volts transfer capability
- 0.01 ppm rms internal noise

Extraordinary Accuracy

- 0.6 ppm for 24 hours in dc volts
- 2.2 ppm for 24 hours in Ω
- 100 ppm mid-band ac volts
- 8 ppm (4 ppm optional) per year voltage reference stability

3458A Multimeter Performance Features

DC Volts

- 5 ranges: 0.1 V to 1000 V
- 8½ to 4½ digits resolution
- Up to 100,000 readings/s (4½ digits)
- Maximum sensitivity: 10 nV
- 0.6 ppm 24-hour accuracy
- 8 ppm (4 ppm optional)/year voltage reference stability

Resistance

- 9 ranges: 10 Ω to 1 GΩ
- 2-wire and 4-wire Ω with offset compensation
- Up to 50,000 readings/second (5½ digits)
- Maximum sensitivity: 10 μΩ
- 2.2 ppm 24-hour accuracy

AC Volts

- 6 ranges: 10 mV to 1000 V
- 1 Hz to 10 MHz bandwidth
- Up to 10 readings/s with all readings to specified accuracy
- Choice of sampling or analog true rms techniques
- 100 ppm best accuracy

DC Current

- 8 ranges: 100 nA to 1 A
- Up to 1,350 readings/s (5½ digits)
- Maximum sensitivity: 1 pA
- 14 ppm 24-hour accuracy

AC Current

- 5 ranges: 100 μA to 1 A
- 10 Hz to 100 kHz bandwidth
- Up to 50 readings/second
- 500 ppm 24-hour accuracy

Frequency and Period

- Voltage or current ranges
- Frequency: 1 Hz to 10 MHz
- Period: 100 ns to 1 second
- 0.01% accuracy
- AC or dc coupled

Throughput

Maximum Reading Rates

- 100,000 readings/s at 4½ digits (16 bits)
- 50,000 readings/s at 5½ digits
- 6,000 readings/s at 6½ digits
- 60 readings/s at 7½ digits
- 6 readings/s at 8½ digits

Measurement System Speed

- 100,000 readings/s over GPIB or with internal memory
- 110 autoranges/s
- 340 function or range changes/s
- Postprocessed math from internal memory

Abbreviated Technical Specifications

DC Voltage

Range	Full Scale	Maximum Resolution	1-Year* Accuracy	Transfer Accuracy 10 min., tref ±0.5°C	Input Impedance
100 mV	120.00000	10 nV	ppm of reading + ppm of range 9(5) + 3	0.5 + 0.5	>10 GΩ
1 V	1.2000000	10 nV	8(4) + 0.3	0.3 + 0.1	>10 GΩ
10 V	12.0000000	100 nV	8(4) + 0.05	0.05 + 0.05	>10 GΩ
100 V	120.000000	1 μV	10(6) + 0.3	0.5 + 0.1	10 MΩ ± 1%
1000 V	1050.00000	10 μV	10(6) + 0.1	1.5 + 0.05	10 MΩ ± 1%

One-year specifications for NPLC 100 within 24 hours and ±1°C of last ACAL. Tcal ±5°C, MATH NULL, fixed range. Add 2 ppm of reading additional error for Agilent factory traceability of 10 V dc to US NIST. Traceability error is the absolute error relative to National Standards associated with the source of last external calibration. Transfer specifications for NPLC 100, following 4-hour warm-up. Full scale to 10% of full scale. Measurements on the 1000 V range are within 5% of the initial measurement value and following measurement settling. Tref is the starting ambient temperature. Measurements are made on a fixed range using accepted metrology practices.* High stability (Option 002) ppm of reading in parentheses.

Noise Rejection (dB)¹

	AC NMR ²	AC ECMR	DC ECMR
NPLC <1	0	90	140
NPLC ≥1	60	150	140
NPLC ≥10	60	150	140
NPLC ≥100	60	160	140
NPLC ≥1000	75	170	140

¹ Applies for 1 kΩ unbalance in the LO lead and ±0.1% of the line frequency currently set for LFREQ.

² For line frequency ±1%, ACNMR is 40 dB for NPLC ≥1, or 55 dB for NPLC ≥100. For line frequency ±5%, ACNMR is 30 dB for NPLC ≥100.

Maximum Input

	Rated Input	Nondestructive
HI to LO	±1000 V pk	±1200 V pk
LO to guard	±200 V pk	±350 V pk
Guard to earth	±500 V pk	±1000 V pk
HI or LO to earth	±1000 V pk	±1200 V pk

True rms AC Voltage

(Synchronous Subsampled Mode)

Range	Full Scale	Maximum Resolution	Accuracy* 24 hour – 2 year 40 Hz to 1 kHz % of reading + % of range	Input Impedance
10 mV	12.00000	10 nV	0.02 + 0.011	1 MΩ ±15% with <140 pf
100 mV	120.00000	10 nV	0.007 + 0.002	1 MΩ ±15% with <140 pf
1 V	1.2000000	100 nV	0.007 + 0.002	1 MΩ ±15% with <140 pf
10 V	12.000000	1 μV	0.007 + 0.002	1 MΩ ±2% with <140 pf
100 V	120.00000	10 μV	0.02 + 0.002	1 MΩ ±2% with <140 pf
1000 V	700.0000	100 μV	0.04 + 0.002	1 MΩ ±2% with <140 pf

* Specifications apply for full scale to 10% of full scale, dc <10% of ac, sine-wave input, crest factor of 1.4. Within 24 hours and ±1°C of last ACAL. Peak (ac+dc) input limited to 5 x full scale for all ranges. Add 2 ppm of reading additional error for Agilent factory traceability of 10 Vdc to US NIST.

Maximum Input

	Rated Input	Nondestructive
HI to LO	±1000 V pk	±1200 V pk
LO to guard	±200 V pk	±350 V pk
Guard to earth	±500 V pk	±1000 V pk
HI or LO to earth	±1000 V pk	±1200 V pk
Volt-Hz product	1 x 10 ⁶	—

Resistance

Range	Full Scale	Maximum Resolution	Current Through Unknown	1-Year Accuracy* (4-wire Ω) ppm of rdg+ppm of range
10 Ω	12.00000	10 μΩ	10 mA	15 + 5
100 Ω	120.00000	10 μΩ	1 mA	12 + 5
1 kΩ	1.2000000	100 μΩ	1 mA	10 + 0.5
10 kΩ	12.000000	1 mΩ	100 μA	10 + 0.5
100 kΩ	120.00000	10 mΩ	50 μA	10 + 0.5
1 MΩ	1.2000000	100 mΩ	5 μA	15 + 2
10 MΩ	12.000000	1 Ω	500 nA	50 + 10
100 MΩ	120.00000	10 Ω	500 nA	500 + 10
1 GΩ	1.2000000	100 Ω	500 nA	0.5% + 10

* Specifications for 100 NPLC, offset compensation on, within 24 hours and ±1°C of last ACAL. Tcal ±5°C. Add 3 ppm of reading additional error for Agilent factory traceability of 10 kΩ to US NIST.

Memory

	Standard Readings	Bytes	Option 001 Readings	Bytes
Reading Storage (16 bit)	10,240	20 k	+65,536	+128 k
Non-volatile, for Subprograms and/or State Storage	—	14 k	—	—

Math Functions

The 3458A performs the following math functions on measurements: NULL, SCALE, OFFSET, RMS FILTER, SINGLE POLE FILTER, THERMISTOR LINEARIZATION, DB, DBM, % ERROR, PASS/FAIL LIMIT TESTING, and STATISTICS. Two math functions may be used at one time.

General Specifications

Operating Temperature: 0°C to 55°C

Warmup Time: Four hours to all specifications except where noted

Humidity Range: 95% RH, 0°C to 40°C

Storage Temperature: –40°C to +75°C

Power: 100/120 V, 220/240 V ± 10%, 48 to 66 Hz, 360 to 420 Hz automatically sensed. Fused at 1.5 A @115 V or 0.5 A @230 V. <30 W, < 80 VA (peak).

Size: 88.9 mm H x 425.5 mm W x 502.9 mm D (3.5 in x 16.75 in x 19.8 in)

Weight: Net, 12 kg (26.5 lb); shipping, 14.8 kg (32.5 lb)

Ordering Information

3458A Multimeter (with GPIB, 20 KB reading memory, and 8 ppm stability)

3458A-001 Extended Reading Memory (expands total to 148 KB)

3458A-002 High-Stability (4 ppm/year) Reference

3458A-A6J ANSI Z540 Compliant Calibration

3458A-907 Front-handle Kit

3458A-908 Rack Flange Kit

3458A-909 Rack Flange Kit (with handles)

Digital Multimeter Accessory Compatibility Chart and Products

Accessory	34401A	34410A	34411A	3458A	34420A ¹	L4411A
34132B Deluxe Test Lead Kit w/retractable sheath	Yes	No	No	Yes	No	No
11059A Kelvin Probe Set	Yes	Yes	Yes	Yes	No	Yes
11062A Kelvin Clip Set	Yes	Yes	Yes	Yes	Yes	Yes
34133A Precision Electronic Probe	Yes	No	No	No	No	No
11060A Surface-Mount Device Probe	Yes	No	No	Yes	No	No
34171B DMM Terminal Connector	Yes	No	No	No	No	No
34172B DMM Calibration Short	Yes	No	No	No	No	No
E2308A Thermistor Temp Probe	Yes ²	No	No	Yes	No	No
34134A AC/DC Current Probe	Yes	No	No	No	No	No
34136A High Voltage Probe	Yes	No	No	No	No	No
34138A Test Lead Set	Yes	Yes	Yes	No	No	Yes
34330A 30 A Current Shunt	Yes	No	No	Yes	No	No
34131A Basic Instrument Transit Case	Yes	No	No	No	Yes	No
34161A Accessory Pouch	Yes	No	No	No	Yes	No
34102A Low Thermal Input Cable	No	No	No	No	Yes	No

¹ Many accessories are listed as incompatible with 34420A because of the specialized termination. Many of these accessories may be rewired onto the low thermal input connector 34104A.

² Need 34812A BenchLink Meter or an external program to do temperature measurement.



34133A



11060A



11059A

Test Leads

34132A/B Deluxe Test Lead Kits

The test leads in these kits feature a 1.4 m flexible cable and a soft Sanoprene over mold for a comfortable grip. They are rated at 1000 V CAT III. Each kit contains red and black test leads, needle point and alligator test lead tips, and red and black retractable hook test leads. Supplied in a reusable nylon pouch. The kits are available with the following banana plug configurations:

Model	Description
34132A	Deluxe test lead kit with straight fixed sheath banana plugs
34132B	Deluxe test lead kit with straight retractable sheath banana plugs

34133A Precision Electronic Test Leads

These precision electronic test leads are designed specifically for working with small components and in dense circuit boards. The test leads are small and light. The spring-loaded tip helps absorb those small movements and the crown point digs into solder. The test leads have a 1.2 m flexible cable, terminated in right angle shrouded banana plugs and have a Sanoprene over-mold for a comfortable grip. Each kit includes one black and one red test lead.

11060A Surface Mount Device Tweezers

The gold plated beryllium copper tweezer design provides an easy method to access and accurately measure SMD resistive networks. Length 1.2 m.

Kelvin Probe and Clips

11059A Kelvin Probe Set

This high quality Kelvin probe set is complete and ready to use for making 4-wire Ohm measurements. The 4 color coded banana jacks and Kelvin clips are both gold plated for maximum conductivity and resistance to corrosion. The probe assembly also includes a ground to guard connector to help remove any ground related errors for the ultimate in high accuracy measurement, ideal for use with the 3458A 8½ digit DMM. The wires are encased in a woven shroud for ease of use and to protect the cables.

11062A Kelvin Clip Set

These silver plated Kelvin clips are ideal for constructing your own Kelvin Probe set for 4-wire Ohm measurements. Each set contains 2 clips.

34131A
34134A
34161A
34171B
34172B
34330A
E2308A



34134A



34330A



34171B



34161A



34131A

3

Current Measurement

34134A DC Coupled Current Probe

A clamp on probe for a wide range of applications such as measuring ground currents, powers ripple or current distribution in systems. Output signals: 1 V/A (1 mV/mA) and 10 mV/A. Frequency range: DC to 2 kHz.

34330A 30 A Current Shunt

This current shunt can be used to extend the current measurement range. Precision 0.001 Ohm resistor. Output is 1 mV per amp of current passing through the shunt. 15 A continuous; 30 A for 15 min continuous.

Temperature Measurement

E2308A Thermistor Temperature Probe

General purpose temperature probe. 5 KOhm @25°C, encapsulated in a stainless steel case. Temperature range: -80°C to 150°C. Accuracy: 0°C to 70°C, ±2%. Time constant: 3 seconds typical.

Miscellaneous DMM Accessories

34171B DMM Terminal Connector

Provides a convenient and reliable method to connect wires to all five input terminals on the 34401A, 34410A, 34411A, and L4411A. Qty. 2

34172B DMM Calibration Short

Provides a convenient and secure method to apply a short to the input connectors of the 34401A, 34410A, 34411A, and L4411A. Qty. 2

34161A Accessory Pouch

Cordura pouch fits on top of the 34401A and 34420A voltmeters as well as the 54131/32/81A counter and the 33120A and 33250A function/arb generators.

34131A Basic Instrument Transit Case

Heavy-duty hard-cover carrying case is constructed from rugged A.B.S. and has rubber-grip steel handles and steel latches. The case can be padlocked. For use with 34401A and 34420A voltmeters as well as the 53131/32/81A counter and the 33120A function/arb generator.

- Measure power without a power meter
- Connect quickly and easily with USB 2.0
- Perform zeroing without disconnecting from device-under-test (DUT)
- Ease monitoring and troubleshooting with feature-packed software
- Perform accurate power measurements with other instruments



Excellent Performance without Compromise

The Agilent U2000 Series USB power sensors allow you to display power measurement on a PC or on other Agilent instruments without the need of a separate power meter. The compact U2000 Series gives you the same functionality and performance as a conventional power meter and sensor. This is a cost-effective solution that leverages the latest diode sensor technologies, hence, you will experience the same level of performance for your power measurements with a lower cost solution.

Simplified Measurement Setup without the Need of an External Power Supply and Triggering Module

The U2000 Series is a complete solution that simplifies your measurement setup and meets all your measurement needs. No external power supply is required to power up the sensor as it utilizes the power from the USB port. The low current consumption (approximately 170 mA) enables a number of USB sensors to be connected to a PC without the need of an external USB hub to supply any additional power.

The U2000 Series consists of built-in triggering circuit that enables measurement synchronization with the external instrument or event, for instance, to control the timing of capturing a pulse signal. With the plug-and-play capability of the U2000 Series, a quick connection can be established between the USB power sensor and the PC for your immediate measurements.

External Calibration-free Measurements

The U2000 Series provides “internal zeroing” that eliminates the needs of disconnecting or powering off the device under test. It integrates a switching circuit into each USB sensor, hence, users can perform the zeroing while the sensor is still connecting to a device under test.

The compact design of U2000 Series also eliminates the sensor calibration that requires an external reference source, and the path loss calibration caused by the different combination of power meter and sensor. Users can rely on the factory calibration to ensure measurement accuracy.

The internal zeroing and calibration-free designs remove the steps to connect and disconnect the power sensor from the calibration source. Hence, it can reduce the test times, measurement uncertainty, and wear and tear of the connector. The USB power sensors can also be embedded into the test fixtures without switching the reference signals.

N1918A Power Panel, the Intuitive Soft Front Panel

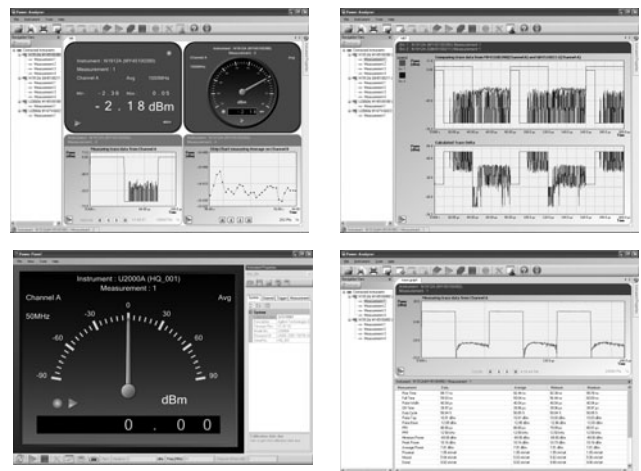


The U2000 Series is bundled with the Power Panel that offers a standard GUI for basic power measurement. The Power Panel can display power measurements in both analog and numerical formats and a trend chart display that monitors up to 10,000 data points. The Power Panel also comes with mathematical functions for multiple channels such as delta, sum and ratio in multi-list measurement.

The software also comes with integrated Help File that guides you through the operations of each function. The provided save and record capability of U2000 Series can be disabled using the password protection. This aims to prevent any unauthorized data storage and to safeguarding sensitive information and measurements. This makes the Agilent U2000 Series suitable to be used in a secure environment.

Easy Monitoring and Troubleshooting with N1918A-100 Power Analyzer

The N1918A Power Analysis Manager offers an orderable option – N1918A-100 Power Analyzer that further extends the capabilities of the U2000 Series.



Key Features of the Advanced Power Analyzer

- Comes with enhanced visualization with larger and more flexible display formats that includes Digital Softpanel, Gauge, Trace Graph, Strip Chart displays and multiple tabs
- Provides complete 15-point pulse characterization for peak power analysis
- Supports overlay measurements and waveform math computations
- Computes statistical power routines on PDF, CDF and CCDF measurements
- Stores up to seven days of data based on preprogrammed measurement schedules
- Provides limits and alert function for remote monitoring
- Offers data logging and timestamp for deviation monitoring and analysis

Power Meters

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U2000 Series USB Power Sensors (cont.)

Low Power Path and High Power Path for Agilent U2000 Series USB Power Sensors

Sensor	Power Range
U2000A, U2001A, U2002A, U2004A	–60 dBm to +20 dBm Low Power Path: –60 dBm to –10 dBm High Power Path: –10 dBm to +20 dBm

Product Specifications for Agilent U2000 Series USB Power Sensors

Model	Frequency Range	Maximum SWR (25°C ± 10°C)	Maximum SWR (0 – 55 °C)	Maximum Power	Connector Type
U2000A	10 MHz to 18.0 GHz	10 MHz to 30 MHz: 1.15 30 MHz to 2 GHz: 1.13 2 GHz to 14 GHz: 1.19 14 GHz to 16 GHz: 1.22 16 GHz to 18 GHz: 1.26	10 MHz to 30 MHz: 1.21 30 MHz to 2 GHz: 1.15 2 GHz to 14 GHz: 1.20 14 GHz to 16 GHz: 1.23 16 GHz to 18 GHz: 1.27	+25 dBm (320 mW) average +33 dBm peak (2 W) <10 µs	Type-N (m)
U2001A	10 MHz to 6.0 GHz	10 MHz to 30 MHz: 1.15 30 MHz to 2 GHz: 1.13 2 GHz to 6 GHz: 1.19	10 MHz to 30 MHz: 1.21 30 MHz to 2 GHz: 1.15 2 GHz to 6 GHz: 1.20	+25 dBm (320 mW) average +33 dBm peak (2 W) <10 µs	Type-N (m)
U2002A	50 MHz to 24 GHz	50 MHz to 2 GHz: 1.13 2 GHz to 14 GHz: 1.19 14 GHz to 16 GHz: 1.22 16 GHz to 18 GHz: 1.26 18 GHz to 24 GHz: 1.30	50 MHz to 2 GHz: 1.15 2 GHz to 14 GHz: 1.20 14 GHz to 16 GHz: 1.23 16 GHz to 18 GHz: 1.27 18 GHz to 24 GHz: 1.30	+25 dBm (320 mW) average +33 dBm peak (2 W) <10 µs	3.5 mm (m)
U2004A	9 kHz to 6.0 GHz	9 kHz to 2 GHz: 1.13 2 GHz to 6 GHz: 1.19	9 kHz to 2 GHz: 1.15 2 GHz to 6 GHz: 1.20	+25 dBm (320 mW) average +33 dBm peak (2 W) <10 µs	Type-N (m)

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Ordering Information

U2000A 10 MHz to 18 GHz, –60 dBm to +20 dBm USB Power Sensor, N-type (m)

U2001A 10 MHz to 6 GHz, –60 dBm to +20 dBm USB Power Sensor, N-type (m)

U2002A 50 MHz to 24 GHz, –60 dBm to +20 dBm USB Power Sensor, 3.5 mm (m)

U2004A 9 kHz to 6 GHz, –60 dBm to +20 dBm USB Power Sensor, N-type (m)

N1918A-100 Power Analyzer

U200xx-100 Connector Type-N

U2000A-201 Transit Case To fit in 4 USB sensors, Operating & service guide, programming guide, cables

U2000A-202 Soft Carrying Case to carry the sensor for field applications

Key Literature & Web Link

U2000 Series USB Power Sensor Data Sheet, p/n 5989-6278EN

U2000 Series USB Power Sensor Technical Overview, p/n 5989-6279EN

U2000 Series USB Power Sensor Configuration Guide, p/n 5989-6281EN

U2000 Series USB Power Sensor Demo Guide, p/n 5989-6280EN

N1918A Power Analysis Manager Technical Overview, p/n 5989-6613EN

N1918A Power Analysis Manager P-Series Power Meter Measurement

Application, p/n 5989-6619EN

Steps for Making Better Power Measurements, Application Note 64-4D,

p/n 5965-8167EN

Choosing the Right Power Meter and Sensor, Product Note,

p/n 5968-7150E

www.agilent.com/find/usbsensor

Cables

A 1.5 m USB 2.0 Compliance cable with USB Mini-B connector and locking mechanism to the sensor is provided as standard

Additional Cables

U2031A: USB 2.0 compliance cable with USB Mini-B connector and locking mechanism, length 1.5 meters (5 ft)

U2031B: USB 2.0 compliance cable with USB Mini-B connector and locking mechanism, length 3 meters (10 ft)

U2031C: USB 2.0 compliance cable with USB Mini-B connector and locking mechanism, length 5 meters (16.7 ft)

- Peak, peak-to-average ratio and average power measurements
- Time-gated power measurements
- Analyzer software for pulse and statistical analysis
- Fast measurement speed over the GPIB (up to 1,000 readings per second with the E4416A and E9320 power sensors)
- 5 MHz video (modulation) bandwidth
- Operates with all E-series and 8480 series power sensors



E4416A and E4417A Peak and Average Power Meters

Comprehensive Measurement Capability for TDMA, CDMA, and W-CDMA Signals

The E4416A and E4417A high-performance, single and dual-channel power meters and E932x peak and average power sensors, provide a low-cost, single-box solution for peak, peak-to-average ratio, average power and time-gated measurements, for the complex modulation formats used in today's and future wireless communications systems.

Time-gated measurements are performed using the meters comprehensive triggering features, such as an external TTL compatible trigger input. Up to 4 simultaneous time-gated measurements can be made. Individual start and duration times can be setup, allowing user's to measure the average, peak, or peak-to-average ratio. For example, on a GSM signal, this capability can be used to measure the average power over 5% to 95% of the burst duration, as well as measuring the peak power and pulse droop.

Fast Measurement Speed without Compromising Accuracy and Repeatability

Faster test times improve manufacturing productivity and efficiency. Designed for both bench and automatic test equipment (ATE) operation, the EPM-P series power meters along with the E9320 sensors, provides a measurement speed, over the GPIB, of 1,000 corrected readings per second.

The meter's 20 Msamples/second continuous sampling rate provides the capability to accurately profile complex modulation formats of up to 5 MHz bandwidth.

"Agilent EPM-P Analyzer" Software

The "Agilent EPM-P Analyzer" VEE operates via the GPIB in a PC or laptop environment, and provides the statistical, power, frequency and time measurements that are required for CDMA and TDMA signals. When the software is in control of the meter, all the meter functions and pre-defined setups are not relevant as the software overrides the meter. It's a VEE run-time program and is supplied as standard with all EPM-P power meters, free of charge, on a CD-ROM. It also comes with a VEE installation program.

Low Cost of Ownership

The EPM-P series power meters come with 2-year calibration cycle, and are fully compatible with the 8480 and E-series power sensors, therefore protecting your investment. This also gives an additional choice for conventional average power measurements.

Specifications

Frequency Range: 9 kHz to 110 GHz, sensor dependent

Power Range: -70 to +44 dBm, sensor dependent

Single Sensor Dynamic Range

- 8480 series sensors: 50 dB maximum
- E-series CW power sensors: 90 dB
- E-series E9300 Average power sensors: 80 dB maximum
- E-series E9320 Peak and Average power sensors:
 - 85 dB maximum (CW mode)
 - 75 dB maximum (peak mode)

Display Units

- Absolute: Watts or dBm
- Relative: Percent or dB

Display Resolution: Selectable resolution of 1.0, 0.1, 0.01, 0.001 dB in logarithmic mode, or 1 to 4 significant digits in linear mode

Measurement Characteristics

- Measurements: Average Power, Peak Power, Peak-to-Average Ratio and measurements between two time offsets (time-gating)
- Analyzer Software: statistical and pulse analysis
- Averaging: Averaging over 1 to 1024 readings
- Modulation Bandwidth:** 5 MHz maximum (set by meter and is sensor dependent)

Instrumentation Accuracy

- Absolute:
 - Logarithmic: ± 0.02 dB; Linear: $\pm 0.5\%$
- Relative:
 - Logarithmic: ± 0.04 dB; Linear: $\pm 1.0\%$

Time Base Accuracy: 0.1%

Trigger Sources: Internal, External TTL, GPIB, RS232/422

Sampling Characteristics

- Sampling Rate: 20 MSamples/second continuous sampling
- Sampling Technique: Synchronous repetitive sampling
- 1 mW Power Reference:** Refer to EPM Series Power Meters

Key Literature

Product Overview, p/n 5980-1471E

Technical Specifications, p/n 5980-1469E

Configuration Guide, p/n 5965-6381E

Application Note 1449 Fundamentals of RF and Microwave Power

Measurements, Part 1 p/n 5988-9213EN, Part 2 p/n 5988-9214EN,

Part 3 p/n 5988-9215EN, Part 4 p/n 5988-9216EN

Application Note 64-4, Four Steps for Making Better Power

Measurements, p/n 5965-8167EN

Product Note, Choosing the Right Power Meter and Sensor, p/n 5968-7150E

Application Note 1438, EPM-P Series Power Meters Used in Radar and

Pulse Applications, p/n 5988-8522EN

Ordering Information

E4416A Power Meter (peak and average, single-channel)

E4417A Power Meter (peak and average, dual-channel)

E4417A-002 Supplies Rear-panel Sensor Input (power reference calibrator is on the front panel)

E4417A-003 Supplies Rear-panel Sensor Input (power reference calibrator is on the rear panel)

E4417A-004 Deletes the E9288A Sensor Cable

E4417A-908 Supplies a One-instrument Rackmount Kit

E4417A-909 Supplies a Two-instrument Rackmount Kit

E4417A-1A7 Supplies ISO17025 Certificate of Calibration with Data

E4417A-A6J Supplies ANSI Z540 Certificate of Calibration with Data

Accessories

34131A Hard Transit Case

34161A Accessory Pouch

34141A Yellow Soft Carry Case

Power Sensor Cables

For operation with E9320 power sensors:

E9288A 1.5 Meters (5 ft)

E9288B 3 Meters (10 ft)

E9288C 10 Meters (31 ft)

For operation with 8480 series, E441x and E9300 power sensors only:

11730A 1.5 Meters (5 ft)

11730B 3 Meters (10 ft)

11730C 6.1 Meters (20 ft)

11730D 15.2 Meters (50 ft)

11730E 30.5 Meters (100 ft)

11730F 61 Meters (200 ft)

Note: The E9288A-C sensor cables will also operate with 8480 and E-series power sensors.

E9321A
E9322A
E9323A
E9325A
E9326A
E9327A

- Operates with the new EPM-P Series Power Meters (E4416A and E4417A)
- Provides peak and average power measurements
- Fast measurement speed over the GPIB (up to 1,000 readings per second)
- 300 kHz, 1.5 MHz and 5 MHz video (modulation) bandwidths
- Wide dynamic range sensors
- Calibration factors stored in EEPROM



E9320 Family Peak and Average Power Sensors

E9320 Family Peak and Average Power Sensors

The E9320 power sensors must be used with an E9288A, B or C sensor cable and only operate with the EPM-P or P-Series power meters. These sensors have two measurement paths, one for peak and time-gated measurements (a fast sampled path) and another for stable, low-level average power measurements.

High Performance Sensors

The E932x sensors have two frequency ranges, from 50 MHz to 6 GHz to cover most wireless communications applications, and a higher frequency range 50 MHz to 18 GHz. Each frequency range has a choice of 3 different video bandwidth sensors:

- 300 kHz for TDMA signals, for example GSM
- 1.5 MHz for cdmaOne
- 5 MHz for W-CDMA and cdma2000

Using just one sensor, user's can measure W-CDMA, cdmaOne and TDMA as each sensor provides a high, medium and low video bandwidth setting, selectable by the meter. So user's can select the modulation bandwidth required for their application, while maintaining the maximum dynamic range.

Fast Measurement Speed

The E9320 power sensors provide fast measurement speed, over the GPIB, up to 1,000 corrected readings per second, with the E4416A power meter.

Optimum Measurement Accuracy and Repeatability

To minimize the sensor and source mismatch, one of the main contributors to the overall measurement uncertainty, the E9320 sensors have a low SWR specification (1.15 for signals <+10 dBm, 50 MHz to 2 GHz). Comprehensive error correction is also provided as the calibration factors, linearity, and temperature compensation data are all stored within the E9320 sensor's EEPROM.

Specifications

Sensor Model	Max. Meas. Bandwidth	Frequency Range	Power Range	Max. Power
E9321A	300 kHz	50 MHz to 6 GHz	-65 to +20 dBm (max.)	+23 dBm average
E9322A	1.5 MHz	50 MHz to 6 GHz	-60 to +20 dBm (max.)	+23 dBm average
E9323A	5 MHz	50 MHz to 6 GHz	-60 to +20 dBm (max.)	+23 dBm average
E9325A	300 kHz	50 MHz to 18 GHz	-65 to +20 dBm (max.)	+23 dBm average
E9326A	1.5 MHz	50 MHz to 18 GHz	-60 to +20 dBm (max.)	+23 dBm average
E9327A	5 MHz	50 MHz to 18 GHz	-60 to +20 dBm (max.)	+23 dBm average

Key Literature

Product Overview, p/n 5980-1471E
 Technical Specifications, p/n 5980-1469E
 Configuration Guide, p/n 5965-6381E
 Application Note 1449 Fundamentals of RF and Microwave Power Measurements, Part 1 p/n 5988-9213EN, Part 2 p/n 5988-9214EN, Part 3 p/n 5988-9215EN, Part 4 p/n 5988-9216EN
 Application Note 64-4, Four Steps for Better Power Measurements, p/n 5965-8167EN
 Product Note, Choosing the Right Power Meter and Sensor, p/n 5968-7150E
 Application Note 1438, EPM-P Series Power Meters Used in Radar and Pulse Applications, p/n 5988-8522EN

Ordering Information

E9321A Power Sensor, 50 MHz to 6 GHz, 300 kHz Bandwidth
E9321A-A6J Supplies ANSI Z540 Certificate of Calibration with Data
E9322A Power Sensor, 50 MHz to 6 GHz, 1.5 MHz Bandwidth
E9322A-A6J Supplies ANSI Z540 Certificate of Calibration with Data
E9323A Power Sensor, 50 MHz to 6 GHz, 5 MHz Bandwidth
E9323A-A6J Supplies ANSI Z540 Certificate of Calibration with Data
E9325A Power Sensor, 50 MHz to 18 GHz, 300 kHz Bandwidth
E9325A-A6J Supplies ANSI Z540 Certificate of Calibration with Data
E9326A Power Sensor, 50 MHz to 18 GHz, 1.5 MHz Bandwidth
E9326A-A6J Supplies ANSI Z540 Certificate of Calibration with Data
E9327A Power Sensor, 50 MHz to 18 GHz, 5 MHz Bandwidth
E9327A-A6J Supplies ANSI Z540 Certificate of Calibration with Data

- Fast measurement speed (up to 200 readings per second with the E4418B, and 100 readings per second with the E4419B, over the GPIB, with E-series sensors)
- Speed improvement of x2 using the 8480-series power sensor (compared to 437B)
- Code-compatible with the 436A and 437B (E4418B) and 438A (E4419B)
- Operates with the 8480 series and E-series (except the E9320A family) plus all 8480 series power sensors
- No range-switching delays with 8480-series sensors (over a 50 dB range), and only one fast-range switch point with E-series sensors (over a 90 dB range)
- Internal rechargeable battery option



EPM Series Power Meters

E4418B Single-Channel Power Meter

The E4418B is a low-cost, high-performance, single-channel, programmable power meter. It is fully compatible with the 8480 series and E-series power sensors, (except the E9320A family). Depending upon which sensor is used, the E4418B can measure from -70 dBm to $+44$ dBm at frequencies from 9 kHz to 110 GHz. Designed for bench and automatic test equipment (ATE) use, the E4418B makes fast (up to 200 readings per second with E-series sensors), accurate and repeatable power measurements.

The E4418B power meter has a high-resolution LCD display with LED backlighting and contrast control. This allows users to see the power readings from a distance, at a wide viewing angle and in a variety of lighting conditions. The user interface is easy to learn and use, with hardkeys for the most frequently used functions, and softkey menus to simplify instrument configuration for different applications. Ten instrument configurations can be saved and recalled, reducing the need to repeat setup sequences.

The E4418B is ideal for service and maintenance applications. The internal rechargeable battery option (Option 001), which provides up to 5.5 hours of continuous operation, brings Agilent's accuracy to field applications. Front and rear panel bumpers protect the E4418B from everyday knocks. The meter weighs only 4 kg (9 lbs), and a bail handle makes it easy to carry.

Because the E4418B power meter is designed to be code-compatible with the previous-generation 436A and 437B power meters, a user's investment in automatic-test procedures, software generation and verification is protected.

E4419B Dual-Channel Power Meter

The E4419B is a low-cost, high-performance, dual-channel, programmable power meter. It is fully compatible with the 8480 series and the E-series power sensors, (except the E9320A family). Depending upon which sensor is used, the E4419B can measure from -70 dBm to $+44$ dBm at frequencies from 9 kHz to 110 GHz.

Designed for bench and automatic test equipment use (ATE), the E4419B makes fast (up to 100 readings per second with E-series sensors), accurate and repeatable power measurements. The E4419B is a true dual-channel power meter, which means that you get two simultaneous power readings on the display.

The E4419B power meter has a high-resolution LCD display with LED backlighting and contrast control. This allows users to see the power readings from a distance, at a wide viewing angle and in a

variety of lighting conditions. Users can display both the digital and analog types of readout on the meter's split screen facility. The analog peaking meter allows users to make accurate adjustments.

The user interface is easy to learn and use, with hardkeys for the most frequently used functions, and softkey menus to simplify instrument configuration for different applications. Difference (A-B, B-A) and ratio (A/B, B/A) functions are provided, and ten instrument configurations can be saved and recalled, reducing the need to repeat set-up sequences.

Because the E4419B power meter is code compatible with the 438A and is the same height (88.5 mm / 3.5 in) and width (212.6 mm / 8.5 in) as the 438A, this makes it easy to substitute into rackmount automatic-test-equipment systems.

Specifications

Frequency Range: 9 kHz to 110 GHz, sensor dependent

Power Range: -70 dBm to $+44$ dBm (100 pW to 25 W), sensor dependent

Power Sensors: Compatible with all 8480 series and E-series sensors

except the E9320A family

Single Sensor Dynamic Range

- 90 dB maximum (E-series sensors)
- 50 dB maximum (8480 series sensors)

Display Units

- Absolute: Watts or dBm
- Relative: Percent or dB

Display Resolution: Selectable resolution of 1.0, 0.1, 0.01, and 0.001 dB in log mode, or 1 to 4 digits in linear mode

Default Resolution: 0.01 dB in log mode, 3 digits in linear mode

Accuracy Instrumentation

- Absolute: ± 0.02 dB (log) or $\pm 0.5\%$ (linear). Add the corresponding power sensor linearity percentage
- Relative: ± 0.04 dB (log) or $\pm 1.0\%$ (linear). Add the corresponding power sensor linearity percentage

Power Reference

Power Output: 1.00 mW (0.0 dBm). Factory set to $\pm 0.4\%$ traceable to the National Physical Laboratory (NPL), UK.

Accuracy

For two years:

- $\pm 0.5\%$ ($23 \pm 3^\circ\text{C}$)
- $\pm 0.6\%$ ($25 \pm 10^\circ\text{C}$)
- $\pm 0.9\%$ (0 to 55°C)

Frequency: 50 MHz nominal

SWR: 1.06 maximum (1.08 maximum for Option 003)

Connector Type: Type N (f), 50 ohms

Key Literature

Brochure, p/n 5965-6380E

Technical Specifications, p/n 5965-6382E

Configuration Guide, p/n 5965-6381E

Application Note 1449 Fundamentals of RF and Microwave Power Measurements, Part 1 p/n 5988-9213EN, Part 2 p/n 5988-9214EN, Part 3 p/n 5988-9215EN, Part 4 p/n 5988-9216EN

Application Note 64-4, Four Steps for Making Better Power Measurements, p/n 5965-8167EN

Product Note, Choosing the Right Power Meter and Sensor, p/n 5968-7150E

Ordering Information

E4418B Power Meter

E4419B Power Meter

E4419B-001 Supplies Internal Rechargeable Battery

E4419B-002 Supplies Rear-panel Sensor Input

(power reference calibrator is on front panel)

E4419B-003 Supplies Rear-panel Sensor Input

(power reference calibrator is on rear panel)

E4419B-004 Deletes the 11730A Sensor Cable

E4419B-908 Supplies a One-instrument Rackmount Kit

E4419B-909 Supplies a Two-instrument Rackmount Kit

E4419B-1A7 Supplies ISO17025 Certificate of Calibration with Data (E4418B/E4419B)

E4419B-A6J Supplies ANSI Z540 Certificate of Calibration with Data

- Operates with the E4418A/B, E4419A/B, E4416A, E4417A, N1911A and N1912A power meters
- Wide dynamic range, -70 to $+44$ dBm, sensor dependent
- Frequency range, 9 kHz to 26.5 GHz, sensor dependent
- Fast measurement speed (up to 200 readings per second, over the GPIB, with the E4418A/B power meter)
- Calibration factors, linearity and temperature compensation data stored in EEPROM



Examples of E-Series Power Sensors

E-Series Power Sensors (E4412A, E4413A and E9300 range)

The E-series diode power sensors are wide dynamic range (90 dB maximum) which operate with the EPM and EPM-P series of power meters.

The E4412A and E4413A sensors are designed for providing power measurements on continuous wave (CW) signals over the range -70 to $+20$ dBm, whereas the E9300 family of power sensors measure the average power of RF and microwave signals, regardless of modulation format, over an 80 dB maximum range.

8480 Power Sensor Family

The 8480 power sensors are for use with the EPM, EPM-P and P-Series power meters, E1416A and the discontinued 70100A and 43X family power meters. These thermocouple and diode power sensors provide extraordinary accuracy, stability, and SWR over a wide range of frequencies (100 kHz to 110 GHz) and power levels (-70 to $+44$ dBm).

E-Series Specifications

Model/Frequency Range	Power Range	Maximum Power	Connector Type
E4412A 10 MHz to 18 GHz	100 pW to 100 mW (-70 to $+20$ dBm)	200 mW ($+23$ dBm)	Type-N (m)
E4413A 50 MHz to 26.5 GHz	100 pW to 100 mW (-70 to $+20$ dBm)	200 mW ($+23$ dBm)	APC-3.5 mm (m)
E9300A 10 MHz to 18 GHz	1 nW to 100 mW (-60 to $+20$ dBm)	320 mW ($+25$ dBm) avg. 2 W ($+33$ dBm) peak (<10 μ sec)	Type-N (m)
E9301A 10 MHz to 6 GHz	1 nW to 100 mW (-60 to $+20$ dBm)	320 mW ($+25$ dBm) avg. 2 W ($+33$ dBm) peak (<10 μ sec)	Type-N (m)
E9304A 9 kHz to 6 GHz	1 nW to 100 mW (-60 to $+20$ dBm)	320 mW ($+25$ dBm) avg. 2 W ($+33$ dBm) peak (<10 μ sec)	Type-N (m)
E9300B 10 MHz to 18 GHz	1 μ W to 25 W (-30 to $+44$ dBm)	0°C to 35°C: 30 W avg. 35°C to 55°C: 20 W avg. <6 GHz: 500 W peak >6 GHz: 125 W peak 500 W μ s per pulse	Type-N (m)
E9301B 10 MHz to 6 GHz	1 μ W to 25 W (-30 to $+44$ dBm)	0°C to 35°C: 30 W avg. 35°C to 55°C: 20 W avg. <6 GHz: 500 W peak 500 W μ s per pulse	Type-N (m)
E9300H 10 MHz to 18 GHz	10 nW to 1 W (-50 to $+30$ dBm)	3.16 W avg. 100 W peak 100 W μ s per pulse	Type-N (m)
E9301H 10 MHz to 6 GHz	10 nW to 1 W (-50 to $+30$ dBm)	3.16 W avg. 100 W peak 100 W μ s per pulse	Type-N (m)

Best SWR in the Industry

Mismatch uncertainty is usually the largest single source of error in power measurements. The 8480 power sensor family gives you extremely low SWR even at mm-wave frequencies. For example, the W8486A power sensor has a specified SWR of less than 1.08:1 over its entire 75 to 110 GHz frequency range. This low SWR translates into minimum mismatch uncertainty and optimum measurement accuracy.

Accurate Calibration and Traceability

Each power sensor in the 8480 family is individually calibrated and traceable to the U.S. National Institute of Standards and Technology (NIST). The uncertainty in this calibration factor is your link to NIST. The cal factor measurement system used by Standards Lab provides you with minimum cal factor uncertainty.

Millimeter-Wave Sensor Calibration

A 50 MHz calibration port is included in Agilent waveguide power sensors for calibration with the power meter. This calibration provides traceability to NIST at millimeter-wave frequencies, and it eliminates the uncertainties due to temperature changes and the variance in making measurements with different meter/sensor combinations.

Key Literature

EPM Power Meter Brochure, p/n 5965-6380E
 E9300 Sensors Product Overview, p/n 5968-4960E
 Technical Specifications, p/n 5965-6382E
 Configuration Guide, p/n 5965-6381E
 Application Note 1449 Fundamentals of RF and Microwave Power Measurements, Part 1 p/n 5988-9213EN, Part 2 p/n 5988-9214EN, Part 3 p/n 5988-9215EN, Part 4 p/n 5988-9216EN
 Application Note 64-4, Four Steps for Making Better Power Measurements, p/n 5965-8167EN
 Product Note, Choosing the Right Power Meter and Sensor, p/n 5968-7150E

Ordering Information

E4412A CW Power Sensor (10 MHz to 18 GHz)
E4413A CW Power Sensor (50 MHz to 26.5 GHz)
E9300A Average Power Sensor (10 MHz to 18 GHz)
E9301A Average Power Sensor (10 MHz to 6 GHz)
E9304A Average Power Sensor (9 kHz to 6 GHz)
E9300B Average Power Sensor (10 MHz to 18 GHz)
E9301B Average Power Sensor (10 MHz to 6 GHz)
E9300H Average Power Sensor (10 MHz to 18 GHz)
E9301H Average Power Sensor (10 MHz to 6 GHz)

8480 Series Specifications

Model	Frequency Range	Maximum SWR	Power Linearity ¹	Maximum Power	Connector Type	Weight
25 Watt Sensors 1 mW to 25 W (0 to +44 dBm)						
8481B	10 MHz to 18 GHz	10 MHz to 2 GHz: 1.10 2 to 12.4 GHz: 1.18 12.4 to 18 GHz: 1.28	+35 to +44 dBm; ±4%	0° to 35°C: 30 W avg ² 35° to 55°C: 25 W avg 0.01 to 5.8 GHz: 500 W pk 5.8 to 18 GHz: 125 W pk 500 W-μs per pulse	Type-N (m)	Net 0.8 kg (1.75 lb) Shipping 1.5 kg (3.25 lb)
8482B	100 kHz to 4.2 GHz	100 kHz to 2 GHz: 1.10 2 to 4.2 GHz: 1.18			Type-N (m)	
3 Watt Sensors 100 μW to 3 W (–10 to +35 dBm)						
8481H	10 MHz to 18 GHz	10 MHz to 8 GHz: 1.20 8 to 12.4 GHz: 1.25 12.4 to 18 GHz: 1.30	+25 to +35 dBm; ±5%	3.5 W avg, 100 W pk 100 W-μs per pulse	Type-N (m)	Net 0.2 kg (0.38 lb) Shipping 0.5 kg (1 lb)
8482H	100 kHz to 4.2 GHz	100 kHz to 4.2 GHz: 1.20			Type-N (m)	
100 mW Sensors 1 μW to 100 mW (–30 to +20 dBm)						
8485A	50 MHz to 26.5 GHz	50 to 100 MHz: 1.15 100 MHz to 2 GHz: 1.10 2 to 2.4 GHz: 1.15 12.4 to 18 GHz: 1.20 18 to 26.5 GHz: 1.25 26.5 to 33 GHz: 1.40	+10 to +20 dBm; ±3%	300 mW avg, 15 W pk 30 W-μs per pulse	APC-3.5 mm (m)	Net 0.2 kg (0.38 lb) Shipping 0.5 kg (1 lb)
Option 033	50 MHz to 33 GHz					
8481A	10 MHz to 18 GHz	10 to 30 MHz: 1.40 30 to 50 MHz: 1.18 50 MHz to 2 GHz: 1.10 2 to 12.4 GHz: 1.18 12.4 to 18 GHz: 1.28			Type-N (m)	
8482A	100 kHz to 4.2 GHz	100 to 300 kHz: 1.60 0.3 to 1 MHz: 1.20 1 MHz to 2 GHz: 1.10 2 to 4.2 GHz: 1.30			Type-N (m)	
8483A	100 kHz to 2 GHz	100 to 600 kHz: 1.80 600 kHz to 2 GHz: 1.18		300 mW avg, 10 W pk	Type-N (m) 75 Ω	
R8486A	26.5 to 40 GHz	1.4	+10 to +20 dBm; ±3%	300 mW avg, 15 W pk 30 W-μs per pulse	Waveguide Flange UG-599/U	Net 0.26 kg (0.53 lb) Shipping 0.66 kg (1.3 lb)
Q8486A	33 to 50 GHz	1.5			Waveguide Flange UG-383/U	
V8486A	50 to 75 GHz	1.04	+10 to +20 dBm; ±2% –30 to +10 dBm <±1%	200 mW avg 40 W pk 10 μs pulse 0.5% duty cycle	Waveguide Flange UG-385/U	Net 0.4 kg (0.91 lb) Shipping 1 kg (2.11 lb)
W8486A	75 to 110 GHz	1.08	±2%	200 mW avg 40 W peak	Waveguide Flange UG-387/U	Net 0.4 kg (0.9 lb) Shipping 1.0 kg (2.1 lb)
8487A	50 MHz to 50 GHz	50 to 100 MHz: 1.15 100 MHz to 2 GHz: 1.10 2 to 12.4 GHz: 1.15 12.4 to 18 GHz: 1.20 18 to 26.5 GHz: 1.25 26.5 to 40 GHz: 1.30 40 to 50 GHz: 1.50	+10 to +20 dBm; ±3%	300 mW avg, 15 W pk 30 W-μs per pulse	2.4 mm (m)	Net 0.14 kg (0.28 lb) Shipping 0.5 kg (1 lb)
High Sensitivity Sensors 100 pW to 10 μW (–70 to –20 dBm)						
8481D^{3,4}	10 MHz to 18 GHz	10 to 30 MHz: 1.40 30 MHz to 4 GHz: 1.15 4 to 10 GHz: 1.20 10 to 15 GHz: 1.30 15 to 18 GHz: 1.35	–30 to –20 dBm; ±1%	100 mW avg 100 mW pk	Type-N (m)	Net 0.18 kg (0.41 lb) Shipping 0.9 kg (2 lb)
8485D³	50 MHz to 26.5 GHz	0.05 to 0.1 GHz: 1.19 0.1 to 4 GHz: 1.15 4 to 12 GHz: 1.19 12 to 18 GHz: 1.25 18 to 26.5 GHz: 1.29 26.5 to 33 GHz: 1.35	–30 to –20 dBm; ±2%	100 mW avg 100 mW pk	APC-3.5 mm (m)	Net 0.2 kg (0.38 lb) Shipping 0.5 kg (1 lb)
Option 033	50 MHz to 33 GHz					
8487D³	50 MHz to 50 GHz	0.05 to 0.1 GHz: 1.19 0.1 to 2 GHz: 1.15 2 to 12.4 GHz: 1.20 12.4 to 18 GHz: 1.29 18 to 34 GHz: 1.37 34 to 40 GHz: 1.61 40 to 50 GHz: 1.89	–30 to –20 dBm; ±2%	100 mW avg 100 mW pk	2.4 mm (m)	Shipping 0.5 kg (1 lb) Net 0.2 kg (0.38 lb)
R8486D³	26.5 to 40 GHz	1.4	–30 to –25 dBm; ±3%	100 mW avg or pk 40 Vdc max	Waveguide Flange UG-599/U	Net 0.26 kg (0.53 lb) Shipping 0.66 kg (1.3 lb)
Q8486D³	33 to 50 GHz	1.4	–25 to –20 dBm; ±5%		Waveguide Flange UG-383/U	

¹ Negligible deviation except for those power ranges noted.² For pulses greater than 30 W the maximum average power (Pa) is limited by the energy per pulse (E) in W – μs according to Pa = 30 – 0.02E.³ Includes 11708A 30 dB attenuator for calibrating against a 0 dBm, 50 MHz power reference. 11708A is factory set to 30 dB ± 0.05 dB at 50 MHz, traceable to NIST. SWR < 1.05 at 50 MHz.⁴ This sensor directly replaces the popular 8484A power sensor.

- 30 MHz video bandwidth
- Single-shot real time sampling at 100 MSa/s
- Zero and calibrate while still connected to the DUT
- Peak, average, peak-to-average ratio power measurements, time measurements of rise time, fall time, pulse width, pulse period, duty cycle, time to positive/negative occurrences and CCDF statistical analysis
- Simplified measurement setup with 22 presets, including WiMAX and WLAN
- USB, LAN, and GPIB connectivity



N1912A P-Series Power Meter (dual channel)

N1911A and N1912A P-Series Power Meters

Designed for Today's Demanding Applications

The N1911A and N1912A single and dual-channel power meters and N192xA sensors deliver the wide bandwidth and high performance measurements that you need to be confident your products are meeting their power specifications.

The P-Series power meters have a 30-MHz video bandwidth and a 100 Msample/s continuous sampling rate for fast, accurate, and repeatable power measurements. When these meters are used with the P-Series wideband power sensors, they provide an extensive measurement capability that has been optimized for aerospace/defense, wireless communication, and wireless networking (802.11a/b/g) applications.

Comprehensive Power and Time Measurements

The P-Series power meters and sensors offer comprehensive measurements that satisfy the requirements of many power applications in R&D and manufacturing.

- Peak power, average power, and peak-to-average power ratio measurements
- Time-gated and free-run measurement modes
- Automatic rise time, fall time, time to positive occurrence and time to negative occurrence

Low Cost of Ownership

Backwards compatibility of the P-Series meters with the current offering of power sensors gives you numerous options for extending the usefulness of your power measurement tools. Identical features and measurements performed by the EPM, EPM-P and P-Series power meters are code compatible, having the same SCPI commands, thus allowing for re-use of test software. A 2-year calibration cycle on the P-Series power meters helps reduce the cost of ownership.

Compatibility with More Than 30 Agilent Sensors

The P-Series power meters also work with 8480 and E-series power sensors. This gives you a selection of more than 30 sensors for peak and average power measurements over a wide dynamic range from -70 to +44 dBm, with frequency coverage from 9 kHz to 110 GHz.

Specifications

General Features

Number of Channels

N1911A P-Series power meter, single channel

N1912A P-Series power meter, dual channel

Frequency Range

N1921A P-Series wideband power sensor, 50 MHz to 18 GHz

N1922A P-Series wideband power sensor, 50 MHz to 40 GHz

Measurements

Average, peak and peak-to-average ratio power measurements are provided with free-run or time gated definition.

Time parameter measurements of pulse rise time, fall time, pulse width, time to positive occurrence and time to negative occurrence are also provided.

Sensor Compatibility

P-Series power meters are compatible with all Agilent P-Series wideband power sensors, E-series sensors and 8480 series power sensors

Key System Specifications and Characteristics

Maximum Sampling Rate

100 Msamples/second, continuous sampling

Video Bandwidth

≥30 MHz

Single Shot Bandwidth

≥30 MHz

Rise Time

≤13 ns (for frequencies >500 MHz)

Fall Time

≤13 ns (for frequencies >500 MHz)

Minimum Pulse Width

50 ns

Dynamic Range

-35 dBm to +20 dBm (>500 MHz)

-30 dBm to +20 dBm (50 MHz – 500 MHz)

Maximum Capture Length

1 second

Maximum Pulse Repetition Rate

10 MHz (based on 10 samples per period)

Timebase

Timebase Range

2 ns to 100 msec/div

Accuracy

10 ppm

Jitter

≤1 ns

Physical Characteristics

Dimensions

The following dimensions exclude front and rear panel protrusions:

88.5 mm H x 212.6 mm W x 348.3 mm D (3.5 in x 8.5 in x 13.7 in)

Net Weight

N1911A: ≤3.5 kg (7.7 lb) approximate

N1912A: ≤3.7 kg (8.1 lb) approximate

Shipping Weight

N1911A: ≤7.9 kg (17.4 lb) approximate

N1912A: ≤8.0 kg (17.6 lb) approximate

Accessories

34131A Basic Instrument Transit Case

34161A Accessory Pouch

Cable Accessories

Sensor cable adapters for use with 8480 and E-Series power sensors only.

N1917A P-Series Meter Cable Adapter, 1.5 m (5 ft)

N1917B P-Series Meter Cable Adapter, 3 m (10 ft)

N1917C P-Series Meter Cable Adapter, 10 m (31 ft)

Key Literature & Web Link

Configuration Guide, p/n 5989-1252EN
Technical Overview, p/n 5989-1049EN
Data Sheet, p/n 5989-2471EN
P-Series Power Meter IEEE 802.16 WiMAX Measurement Application,
p/n 5989-6423EN
P-Series Power Sensor Internal Zeroing and Calibration for RF Power
Sensors, p/n 5989-6509EN

www.agilent.com/find/wideband_powermeters

N1911A

N1912A

Ordering Information

N1911A P-Series Power Meter (single channel)

N1912A P-Series Power Meter (dual channel)

N1912A-003 Rear Panel Sensor and Power Reference Connectors

N1912A-908 Supplies a One-instrument Rackmount Kit

N1912A-909 Supplies a Two-instrument Rackmount Kit

N1912A-1A7 Supplies an ISO17025 Certificate of Calibration with Data

N1912A-A6J Supplies ANSI Z540 Certificate of Calibration with Data

N1921A
N1922A

- Operates with the new P-Series Power Meters (N1911A and N1912A)
- Zero and calibrate while still connected to the DUT
- Measurement frequency range to 40 GHz
- Wide dynamic range peak power measurements



N192xA P-Series Wideband Power Sensors

N192xA Wideband P-Series Power Sensors

The N1921A (50 MHz to 18 GHz) and the N1922A (50 MHz to 40 GHz) only operate with the P-Series power meters. These sensors have their sensor cable permanently connected (hard-wired) to ensure the best wide bandwidth flatness specifications.

External Calibration-free Measurements

The P-Series power sensors are the first to provide ‘**internal zero and calibration**’ which eliminates the need for sensor calibration using an external reference source. Agilent’s patent-pending technology integrates a dc reference source and switching circuits into each power sensor, so that you can zero and calibrate the sensor while it is connected to a device under test. This feature removes the need for connection and disconnection from the calibration source, thereby reducing test times, measurement uncertainty, and wear and tear on connectors. It is especially useful in manufacturing and automated test environments where every second counts. Sensors can be embedded within test fixtures without the need to switch in reference signals.

Simplified Correction Factors

To ensure the accuracy of power measurements, a power meter typically overlays many different sensor correction factors, including linearity, frequency and temperature. At higher bandwidths, this technique can be cumbersome and less than accurate. To simplify the process and improve measurement speed while preserving measurement accuracy, Agilent uses a 4-dimensional modeling technique that measures input power, frequency, temperature, and output voltage across the power sensor’s specified measurement ranges. Data from this 4-D model is generated during the initial factory calibration of the sensor and stored in EEPROM, and advanced algorithms are used to quickly and accurately evaluate the sensors against this model, without requiring the power meter to interpolate the calibration factors and linearity curves. If you run tests in which the frequency changes often – testing multi-carrier amplifiers on different bands, for example – you’ll notice a marked improvement in measurement speed.

Specifications

Sensor Model	Frequency Range	Dynamic Range	Damage Level	Connector Type
N1921A	50 MHz – 18 GHz	–35 dBm to +20 dBm (>500 MHz) –30 dBm to +20 dBm (50 MHz – 500 MHz)	+23 dBm (average power); +30 dBm (<1 μ s duration) (peak power)	Type N (m)
N1922A	50 MHz – 40 GHz	–35 dBm to +20 dBm (>500 MHz) –30 dBm to +20 dBm (50 MHz – 500 MHz)	+23 dBm (average power); +30 dBm (<1 μ s duration) (peak power)	2.4 mm (m)

Maximum SWR

Frequency Band	N1921A/N1922A
50 MHz to 10 GHz	1.2
10 GHz to 18 GHz	1.26
18 GHz to 26.5 GHz	1.3
26.5 GHz to 40 GHz	1.5

Sensor Calibration Uncertainty

Definition: Uncertainty resulting from non-linearity in the sensor detection and correction process. This can be considered as a combination of traditional linearity, cal factor and temperature specifications and the uncertainty associated with the internal calibration process.

Frequency Band	N1921A	N1922A
50 MHz to 500 MHz	4.5 %	4.3%
500 MHz to 1 GHz	4.0 %	4.2%
1 GHz to 10 GHz	4.0 %	4.4%
10 GHz to 18 GHz	5.0 %	4.7 %
18 GHz to 26.5 GHz		5.9%
26.5 GHz to 40 GHz		6.0%

Physical Characteristics

Dimensions

N1921A: 135 mm x 40 mm x 27 mm

N1922A: 127 mm x 40 mm x 27 mm

Weight

Weights with cable:

Option 105: 0.4 kg

Option 106: 0.6 kg

Option 107: 1.4 kg

Fixed Sensor Cable Lengths

1.5 m (5-feet); Standard

3.0 m (10-feet); Option 106

10 m (31-feet); Option 107

Key Literature & Web Link

Configuration Guide, p/n 5989-1252EN

Technical Overview, p/n 5989-1049EN

Data Sheet, p/n 5989-2471EN

www.agilent.com/find/wideband_powermeters

Ordering Information

N1921A P-Series Wideband Power Sensor (50 MHz to 18 GHz)

N1922A P-Series Wideband Power Sensor (50 MHz to 40 GHz)

N1922A-105 Fixed 1.5 m (5-feet) Cable Length (standard)

N1922A-106 Fixed 3 m (10-feet) Cable Length

N1922A-107 Fixed 10 m (31-feet) Cable Length

N1922A-1A7 Supplies an ISO17025 Certificate of Calibration with Data

Electronic Counters

Starting with the first frequency-measurement projects in the 1940s, Hewlett-Packard pioneered the major technologies enabling today's electronic counters. Today, Agilent Technologies offers a broad line of electronic counters and counter/timers.

Electronic counter/timers are used throughout most technical industries for measuring and analyzing frequency, phase, and time-interval signal characteristics. The breadth of the Agilent offering allows the best product to be selected for each application. An ideal functional and performance fit delivers the greatest value: the best and most cost-effective solution.

Agilent counter/timers offer:

- High-measurement accuracy
- Fast system throughput/GPIB capability
- Low cost of ownership
- Ease of use
- Triggering simplicity

Counter Products

RF Counter

The 53181A leads off Agilent's line of frequency counters. The 53181A RF counter employs continuous measurement technology to provide superior performance at a very low price. Frequency and period measurements are provided over the range of 0.1 Hz to 225 MHz with exceptional resolution of 10 digits in one second. An optional second channel increases the frequency range to 1.5 GHz, 3 GHz, 5 GHz, or 12.4 GHz, making it easy to cover your exact RF measurement needs. Other features of the 53181A include GPIB, automatic limit testing, analog display mode, single-button recall, extensive in-box statistical and math analysis, and more.

The 53181A RF counter is designed for systems and bench applications where high-precision frequency measurements are required in an easy-to-use, small and rugged package.

53181A: The low-cost RF counter for systems and bench use



The 53181A RF counter offers outstanding measurement performance in a low-cost, easy-to-use package.



The 53131A frequency counter offers high performance for system or bench.

Universal Frequency and Time Interval Counters

The Agilent universal counter/timers incorporate frequency measurements, just like the 53181A, and additional capabilities for time-interval measurements. Specifically, these counters measure precise timing between two trigger events. These high-performance universal products also provide complete, automatic characterization of rise time, pulse width, and other signal parameters. Options are available (frequency extensions, high-precision time bases) to customize the products.

The current Agilent frequency counter offering includes two high-performance universal counters: the 53131A and 53132A.

The 53131A is designed for manufacturing test, troubleshooting, and service. This counter allows you to easily make highly reliable frequency and timing measurements. Featured are extensive in-box analysis, automatic limit testing, analog display mode, single button recall, and more. The 53131A's half-rack size and light weight make it well suited for both benchtop and rackmounting.

The 53132A is designed for high-performance ATE systems. It combines the functionality of the 53131A with improved frequency and time interval resolution.

53131A: High-performance system and bench counter (10 digits/sec. and 500 ps LSD). Frequency range up to 225 MHz on 2 channels (with optional 3, 5 or 12.4 GHz on the third channel).

53132A: Highest resolution universal counter for system applications (12 digits/sec. and 150 ps LSD). Frequency range up to 225 MHz on 2 channels (with optional 3, 5 or 12.4 GHz on the third channel).

Microwave and Millimeter-Wave Frequency Counters

These products provide fundamental high-performance frequency measurements, dc to 46 GHz. Many enhancements – power measurement, battery operation, systems interface (GPIB), and high-accuracy time bases – are available standard or as options.

53150A/53151A/53152A: Portable CW microwave counter with power measurement for telecommunications service

53147A/53148A/53149A: Portable CW microwave counter with dc DVM plus true power meter for improved power accuracy

High-Precision Oscillators

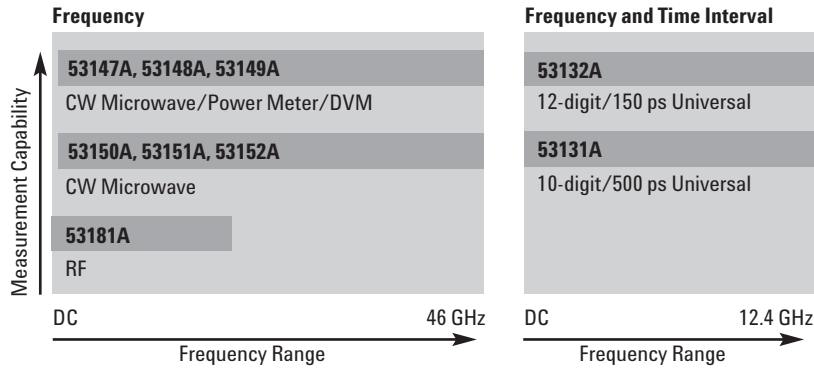
The accuracy of frequency and time-interval measurements is vitally dependent on the time base or reference element selected. Agilent has pioneered the field of high-precision crystal oscillators. The current counter product line benefits from Agilent's leadership in quality and precision oscillator technology. Three oscillator varieties are standard or optional with Agilent counters and counter/timers:

RTX0: Room-temperature crystal oscillators are designed for minimum frequency change over a change in temperature.

TCX0: Temperature-compensated oscillators use external components to offset temperature effects. TCX0 time bases have temperature characteristics which are typically five times better than an RTX0, or $<5 \times 10^{-7}$ for a 0° to 50°C change.

Oven Time Base: This alternative places the crystal and temperature-sensitive elements within a temperature-controlled environment. A heating element maintains a consistent temperature. The best stability is achieved when the operating point is 15° to 20°C above the highest temperature to which the unit will be exposed. After warm-up, the frequency remains very stable, typically $<7 \times 10^{-9}$ over a 0° to 50°C variation.

For more information, please request Application Note 200-2, "Fundamentals of Quartz Oscillators" from the Agilent Call Center in your region.



Counter Selection Guide

Model	Frequency Range (extension)	Freq. Resolution (1 s gate time)	Best Sensitivity	Time-Interval Res. (single-shot LSD)	Additional Features
Universal Counters					
53131A Optional 3rd channel	225 MHz (3, 5, 12.4 GHz)	10 digits	20 mV _{rms}	500 ps	GPIO standard, full math, statistics, limit testing, auto pulse characterization
53132A Optional 3rd channel	225 MHz (3, 5, 12.4 GHz)	12 digits	20 mV _{rms}	150 ps	GPIO standard, full math, statistics, limit testing, auto pulse characterization
RF Counter					
53181A Optional 2nd channel	225 MHz (1.5, 3, 5, 12.4 GHz)	10 digits	20 mV _{rms}	—	GPIO standard, full math, statistics, limit testing
CW Microwave Counters					
53150A	20 GHz	1 Hz	−30 dBm	—	GPIO standard, battery optional, simultaneous power measurement
53151A	26.5 GHz	1 Hz	−30 dBm	—	GPIO standard, battery optional, simultaneous power measurement
53152A	46 GHz	1 Hz	−30 dBm	—	GPIO standard, battery optional, simultaneous power measurement
CW Microwave Counter/Power Meter/DVMs					
53147A	20 GHz	1 Hz	−30 dBm	—	DVM and GPIO standard, battery optional, −70 dBm to +20 dBm true power meter
53148A	26.5 GHz	1 Hz	−30 dBm	—	DVM and GPIO standard, battery optional, −70 dBm to +20 dBm true power meter
53149A	46 GHz	1 Hz	−30 dBm	—	DVM and GPIO standard, battery optional, −70 dBm to +20 dBm true power meter

- High-resolution frequency measurements to 225 MHz (optional 1.5, 3.0, 5.0 or 12.4 GHz)
- High-resolution time-interval measurements with 53131A and 53132A
- Intuitive user interface with shallow menu structure
- GPIB standard with data transfer rate of up to 200 fully-formatted measurements/second; talk-only RS-232
- Limit test capability
- IntuiLink Connectivity Software included
- 53181A: 10-digit/s resolution
- 53131A: 10-digit/s and 500 psec resolution
- 53132A: 12-digit/s and 150 psec resolution

53131A
53132A
53181A



53181A RF Counter



53131A and 53132A Universal Counters

A Full Family of High-Performance RF and Universal Counters

Within Budget, Without Compromise

The 53131A/132A/181A high-performance counters offer exceptional price and performance in a rugged, lightweight package with a unique combination of ease of use, complete measurement set, extensive analysis capability, reliability, and high measurement and data transfer speed.

These instruments use real-time digital signal processing technology to analyze data while simultaneously taking new readings, speeding measurement throughput. The technology allows the counters to gather more data for each measurement so you get the high-resolution measurements in a fraction of the time it takes a conventional counter.

Powerful Analysis Capability

The 53131A/132A/181A counters offer built-in statistics and math functions so you can scale measurements and simultaneously measure and track average, min./max. and standard deviation. Automated limit testing lets you set upper and lower limits for any measurement. When a measurement falls outside those limits, the counters log the out-of-limit conditions, notify the operator and generate an output signal to trigger external devices or stop the test. An analog display mode carries limit testing one step further, letting you see at a glance whether a measurement falls within pass/fail limits.



Analog display mode uses an asterisk to represent the current measurement relative to user-defined upper and lower limits. The colon on the left represents the lower limit and the colon on the right represents the upper limit.

High-Speed Automated Test Capability

For computer-controlled systems applications, each counter includes a standard GPIB interface with a data transfer rate of up to 200 fully-formatted measurements per second. The counters use the Standard Commands for Programmable Instruments (SCPI) protocol, letting you leverage your programming investment across your measurement system. The standard RS-232 talk-only interface provides printer support or data transfer to a computer through a terminal-emulation program.

53181A RF Counter

Optimized for RF applications, the single-channel 53181A gives you frequency, period, and peak-voltage measurements with up to 10 digits/sec frequency and period resolution. The low-cost 53181A counter is ideal for benchtop, system RF and analog applications.

A digit-blanking function lets you easily eliminate unnecessary digits when you want to read measurements quickly. For higher-frequency measurements, an optional second channel provides 1.5, 3, 5 or 12.4 GHz bandwidth.

53131A and 53132A Frequency Counters

The two-channel 53131A counter offers 10 digits per second of frequency and period resolution at up to 225 MHz. Single-shot time-interval resolution is specified at 500 ps and averaging can reduce this even further. Measurements include frequency, time interval, ratio, period, phase angle, totalize, peak voltage, pulse parameters and more. For quick access to frequently used tests, a single keystroke recalls up to 20 different stored front-panel set-ups. Choose the 53131A for general bench or system test where you need excellent performance at an unbeatable price.

For applications requiring higher resolution, the 53132A offers the same features and functions as the 53131A with up to 12 digits/s frequency and period resolution. Single-shot time-interval resolution is specified at 150 ps. Choose the 53132A when you need the very best in accuracy and resolution, or when speed in an automated system is critical. With the 53132A, expanded external arming features can be used to control time interval measurements using an external signal.

Whichever counter you choose, you'll have an accurate, reliable counter that will serve you for years to come.

Options Increase Versatility

The 53131A/132A/181A counters can be ordered with an optional RF-input channel to provide frequency measurements up to 3 GHz (531xxA-030), 5 GHz (531xxA-050) or 12.4 GHz (531xxA-124).

A choice of optional timebases is available for the 53131A/132A/181A counters to increase your measurement accuracy. Option 531xxA-010 provides a high-stability oven timebase with aging of less than 5×10^{-10} per day. Option 53132A-012 provides an ultra-high-stability oven timebase with aging of less than 1×10^{-10} per day.

Agilent IntuiLink for counters software turns your PC and counter into a powerful, easy-to-use measurement system. IntuiLink lets you easily configure and run tests from your Windows-based PC, making data gathering more convenient. IntuiLink software helps you get more information from your data by providing a variety of basic display formats and analysis tools that let you manipulate and understand your data quickly and easily.

Electronic Counters

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Frequency and Time Interval Counters (cont.)

Abridged Measurement Specification & Characteristics

	53131A	53132A	53181A
Measurements	Frequency, frequency ratio, time interval, period, rise/fall time, positive/negative pulse width, duty cycle, phase (CH 1 to CH 2), totalize, peak voltage, time interval average, time interval delay		Frequency, frequency ratio (with optional CH 2), period, peak voltage
Analysis	Automatic limit testing, math (scale and offset), statistics (minimum, maximum, mean, standard deviation). Statistics available on all measurements or only measurements that fall within limits.		
Measurement Characteristic			
Frequency range	CH 1 & 2: dc – 225 MHz	CH 1 & 2: dc – 225 MHz	CH 1: dc – 225 MHz
Frequency resolution	10 digits/s	12 digits/s	10 digits/s
Time interval resolution (LSD)	500 ps	150 ps	—
Measurement speed	Up to 200 meas/s over GPIB	Up to 200 meas/s over GPIB	Up to 200 meas/s over GPIB
Voltage Range & Sensitivity (Sinusoid)			
DC to 100 MHz	20 mV _{rms} to ±5 Vac + dc	20 mV _{rms} to ±5 Vac + dc	20 mV _{rms} to ±5 Vac + dc
100 MHz to 200 MHz	30 mV _{rms} to ±5 Vac + dc	30 mV _{rms} to ±5 Vac + dc	30 mV _{rms} to ±5 Vac + dc
200 to 225 MHz	40 mV _{rms} to ±5 Vac + dc	40 mV _{rms} to ±5 Vac + dc	40 mV _{rms} to ±5 Vac + dc
Input Conditioning	(Independently selectable on CH 1 & 2)	(Independently selectable on CH 1 & 2)	(Selectable on CH 1)
Impedance, coupling	1 MΩ or 50 Ω, ac or dc	1 MΩ or 50 Ω, ac or dc	1 MΩ or 50 Ω, ac or dc
Low pass filter	100 kHz, switchable	100 kHz, switchable	100 kHz, switchable
Attenuation	x1 or x10	x1 or x10	x1 or x10
External Timebase Reference Input	1, 5, 10 MHz	10 MHz	1, 5, 10 MHz
Trigger	CH 1 & 2 Trigger on rising/falling edge; set level by percent of signal level or absolute voltage; set sensitivity to LOW, MED, or HIGH	CH 1 & 2	CH 1
Gating and Arming	Auto, manual (set gate time or number of digits of resolution); external, delay (expanded on 53132A)		
Interfaces	GPIB (IEEE 488.1 and 488.2) with SCPI-compatible language; talk only RS-232		
Software	Includes IntuiLink Connectivity Software		
Power	100 to 120 VAC ± 10% –50, 60 or 400 Hz ± 10% } AC line voltage selection is automatic 220 to 240 VAC ± 10% –50 or 60 Hz ± 10%		
Net Weight/Size	3 kg (6.5 lbs), 88.5 mm H x 212.6 mm W x 348.3 mm D (3.54 in x 8.50 in x 13.932 in)		

For full specifications, request a Product Overview, or visit our web site: www.agilent.com/find/counter

Standard and Optional High-Stability Timebases

	Standard (0° to 50°C)	Medium Stability Oven (Option 001)	High Stability Oven (Option 010)	Ultra High Stability Oven (Option 012, 53132A only)
Temperature Stability (referenced to 25°C)	<5 x 10 ⁻⁶	<2 x 10 ⁻⁷	<2.5 x 10 ⁻⁹	<2.5 x 10 ⁻⁹
Aging Rate (after 30 days)				
Per Day		<4 x 10 ⁻⁸	<5 x 10 ⁻¹⁰	<1 x 10 ⁻¹⁰
Per Month	<3 x 10 ⁻⁷	<2 x 10 ⁻⁷	<1.5 x 10 ⁻⁸	<3 x 10 ⁻⁹
Per Year				<2 x 10 ⁻⁸
Turn-on Stability vs. Time (in 30 minutes)		<2 x 10 ⁻⁷ (referenced to 2 hours)	<5 x 10 ⁻⁹ (referenced to 24 hours)	<5 x 10 ⁻⁹ (referenced to 24 hours)
Calibration	Manual Adjust	Electronic	Electronic	Electronic

Note that power to the time base is maintained when the counter is placed in standby via the front panel switch. The internal fan will continue to operate under this condition to maintain long-term instrument reliability.

Optional High-Frequency Channels

	Frequency Range	Coupling	Power Range and Sensitivity	Damage Level
53181A-015¹ 1.5 GHz channel	100 MHz to 1.5 GHz	ac	–27 dBm to +19 dBm	5 V _{rms}
531xxA-030 3.0 GHz channel	100 MHz to 3.0 GHz	ac	–27 dBm to +19 dBm (100 MHz to 2.7 GHz) –21 dBm to +13 dBm (2.7 GHz to 3 GHz)	5 V _{rms}
531xxA-050 5.0 GHz channel	200 MHz to 5.0 GHz	ac	–23 dBm to +13 dBm	25 dBm
531xxA-124 12.4 GHz channel	200 MHz to 12.4 GHz	ac	–23 dBm to +13 dBm	25 dBm

¹ Option 015 is available only for 53181A counters.

Ordering Information

53131A Frequency Counter
53132A Frequency Counter
53181A RF Counter
531xxA-001 Medium-Stability Timebase
531xxA-010 High-Stability Timebase
53132A-012 High-Stability Timebase (53132A only)
53181A-015 1.5 GHz Ch. w/BNC Connector (53181A only)
531xxA-030 3 GHz Channel with BNC Connector
531xxA-050 5 GHz Channel with Type-N Connector
531xxA-124 12.4 GHz Channel with Type-N Connector
531xxA-060 Rear-Panel Connectors
531xxA-A6J ANSI Z540 Compliant Calibration
531xxA-1CM Rackmount Kit
34161A Accessory Pouch
34131A Hard Transit Case

- Ultra wide range, single input (from 50 MHz up to 46 GHz)
- Simultaneous frequency and power measurement with analog peaking indicator
- Fully programmable via GPIB and RS-232 standard
- Lightweight with optional battery

53150A
53151A
53152A



53152A

53150A, 53151A, 53152A Microwave Counters

The Agilent 53150 series represent a total re-thinking of microwave counters: innovative designs that offer no-compromise performance and quality while attaining true portability. The 53150A, 53151A, and 53152A measure both frequency and power over the frequency ranges of 20 GHz, 26.5 GHz, and 46 GHz, respectively, and feature a single, extremely wideband microwave input (50 MHz up to 46 GHz).

No Compromise Performance

Utilizing a unique single board design with low phase noise PLL circuitry, the 53150 series offers exceptional sensitivity, excellent power measurement accuracy and repeatability as well as fast acquisition times and full programmability. Performance equals or surpasses the industry standard Agilent 5350 series in virtually every aspect, and in a package that is less than half the weight and size.

Frequency and Power Measurements with a Single Connection

The heart of the 53150 series is an advanced sampler design that integrates a separate zero bias Schottky diode for the accurate measurement of input power. This allows the convenient measurement of both frequency and power with a single connection. The unique cable-loss-compensation feature (power correction) yields accuracies and repeatabilities that rival power meters. Best of all, since the frequency of the test signal is measured simultaneously, the diode's frequency response is automatically adjusted for. And like the latest in diode sensors, deviation from square law is also compensated for.

Functionality Without Clutter

The 53150 series offers a clean, uncluttered front panel with a minimum of push buttons. Despite their simple appearance, these counters retain all the powerful functions one expects in precision instrumentation, with such useful functions as: measurement averaging, arbitrary as well as nulling offsets for both frequency and power, display of power in either dBm or Watts and full control of resolution, sampling rate, and GPIB address plus extensive self-diagnostics.

Field Tough but Ready for Benchtop or ATE Applications

The 53150 series is as comfortable in the field as in the laboratory. The rugged case with an integrated tilting handle can tolerate the vibration and shock expected in field use. For easy transportation, a soft carrying case is also available. The "see anywhere" backlit LCD display ensures visibility in all environments, from dark to full sunlight. And in situations where AC is unavailable, the internal, replaceable camcorder batteries provide over 2.5 hours of continuous operation. Alternatively, the unit can be powered from an external 11-18 VDC source.

For benchtop and ATE applications, the 53150 series delivers full functionality and high measurement speed along with fully programmable RS-232 interface and high speed GPIB (SCPI compliant) as standard. In addition, these counters are compatible with standard Agilent rackmount hardware.

53150 Series Abridged Measurement Specifications and Characteristics

All measurement specifications are over the full signal ranges of channels 1 and 2. For full specifications or request a Product Overview for the 53150 series microwave counters, please visit our web site www.agilent.com/find/frequencycounters

Input Characteristics

	Input 1 (1 M Ω)	Input 2 (50 Ω)
Frequency Range		
53150A	10 Hz to 125 MHz	0.05 – 20 GHz
53151A	10 Hz to 125 MHz	0.05 – 26.5 GHz
53152A	10 Hz to 125 MHz	0.05 – 46 GHz
Sensitivity	53150/51	53152
<30 Hz	40 mV _{rms}	—
to 125 MHz	25 mV _{rms}	—
<300 MHz	—	–20 dBm
to 12.4 GHz	—	–33 dBm
to 18 GHz	—	–33 dBm
to 20 GHz	—	–29 dBm
to 26.5 GHz	—	–25 dBm (151)
to 40 GHz	—	–23 dBm
to 46 GHz	—	–17 dBm
Maximum Input	2 V _{rms}	+5 dBm, <2 GHz +13 dBm, >2 GHz
Damage Level	5 V _{rms} to 120 Vp	+27 dBm
Coupling	AC	AC

Channel 1

Resolution: Selectable 1 Hz to 1 MHz

Connector: BNC female

Low Pass Filter: 50 kHz, selectable

Channel 2

Resolution: Selectable 1 Hz to 1 MHz

Acquisition Time: 100 ms to 140 ms

Gate Time: 1/Resolution

FM Tolerance: 20 MHz p-p max. @10 MHz rate to 26.5 GHz;
12 MHz p-p max. @10 MHz rate to above 26.5 GHz

AM Tolerance: Any depth/rate within dynamic range of input

Amplitude Discrimination (above 250 MHz): 20 dB typ. for greater than 75 MHz separation; 10 dB typ. for less than 75 MHz separation

Connector: 3.5 mm SMA compatible (53150A/53151A);
2.92 mm removable (53152A)

Power Measurement

Range: Counter sensitivity to +7 dBm

Units: dBm or milliwatts/microwatts

Resolution: 0.01 dB

Accuracy* (0 to –20 dBm):

	53150/51	53152
<12.4 GHz	±1.5 dB	±1.0 dB
to 20 GHz	±1.5 dB	±1.5 dB
to 26.5 GHz	±2.0 dB (151)	±1.5 dB
to 46 GHz	—	±2.0 dB

* At channel two input connector

General

Display: Backlit LCD

Sample Rate: User-selectable Fast, Medium, Slow or Hold

Programming: GPIB and RS-232C, SCPI compatible

Math Functions

- Offset: Last reading and/or entered offset to reading for either power or frequency
- Averaging: 1 to 99 measurement running average
- Power Correction (Cable Loss Compensation): Offsets power reading via linear interpolation of up to 10 user-entered frequency attenuations

Save and Recall: Up to 9 complete instrument setups may be saved and later recalled

Sleep Mode (battery option only): Automatically activated if no input is present for 5 minutes

Power Requirements

- 75 VA max. (25 W typ.)
- 90 – 132 VAC; 50, 60, 400 Hz
- 216 – 264 VAC; 50, 60 Hz
- 11 – 18 VDC; 2 A max.: battery option only

Battery (option):

- Type: VHS camcorder, sealed lead acid (2 each)
- Charge Time: 8 hours in unit
- Capacity: 2.5 hours minimum at 25°C

Timebase:

	TCX0 (std)	Option 001
Aging Rate	1 x 10 ⁻⁷ /mo	5 x 10 ⁻¹⁰ /day
Short Term (1 sec. avg.)	1 x 10 ⁻⁹	2 x 10 ⁻¹⁰
Temperature (0° – 55°C)	<1 x 10 ⁻⁶	1 x 10 ⁻⁸

Accessories Furnished: Power cord and operating, programming, and service manuals

Size: 88.5 mm H x 213 mm W x 300 mm D (3.54 in x 8.52 in x 12 in)

Weight: 4 kg (8.8 lb) without battery option; 6.4 kg (14.08 lb) with battery option

Ordering Information

53150A 20 GHz Microwave Counter

53151A 26.5 GHz Microwave Counter

53152A 46 GHz Microwave Counter

5315xA-001 Oven Timebase

5315xA-002 Battery/DC Input

5315xA-007 Soft Carrying Case

5315xA-A6J ANSI Z540 Compliant Calibration

5315xA-1CM Rack Mounting Kit

- Three frequency ranges up to 46 GHz
- True power meter with 8480 series sensors
- DVM standard and battery optional
- Fully standard programmable GPIB and RS-232 standard



53149A

53147A, 53148A, 53149A Microwave Counter/Power Meter/DVMs

The Agilent 53140 series microwave counter/power meter/DVMs have all the fundamental measurements required to install and maintain today's digital microwave radio links. Rugged field portability and a battery option complete the ensemble. These instruments are also at home in ATE applications with GPIB and RS-232 fully programmable I/O ports as standard features. For those demanding R&D application, the 53140 series offer the laboratory-level performance and accuracy you've come to expect from Agilent Technologies.

53140 Series Measurement

Specifications and Characteristics

For full specifications or request a Product Overview for the 53140 series microwave counters, please visit our web site www.agilent.com/find/frequencycounters

Counter Specifications

Input Characteristics

	Input 1 (1 M Ω)	Input 2 (50 Ω)	
Frequency Range			
53147A	10 Hz to 125 MHz	0.05 – 20 GHz	
53148A	10 Hz to 125 MHz	0.05 – 26.5 GHz	
53149A	10 Hz to 125 MHz	0.05 – 46 GHz	
Sensitivity			
		53147A/48A	53149A
<30 GHz	40 mV _{rms}	—	—
to 125 MHz	25 mV _{rms}	—	—
<250 GHz	—	–20 dBm	–20 dBm
to 12.4 GHz	—	–33 dBm	–33 dBm
to 18 GHz	—	–33 dBm	–30 dBm
to 20 GHz	—	–29 dBm	–27 dBm
to 26.5 GHz	—	–25 dBm (148)	–27 dBm
to 40 GHz	—	—	–23 dBm
to 46 GHz	—	—	–17 dBm
Damage Level			
	5 V _{rms} to 120 Vp	+27 dBm	

Channel 1

Resolution: Selectable 1 Hz to 1 MHz

Low Pass Filter: 50 kHz, selectable

Channel 2

Resolution: Selectable 1 Hz to 1 MHz

Acquisition Time: 100 ms to 140 ms

Gate Time: 1/Resolution

FM Tolerance

• 20 MHz p-p max. @10 MHz rate to 26.5 GHz

• 12 MHz p-p max. @10 MHz rate to >26.5 GHz

Amplitude Discrimination (above 250 MHz): 20 dB typ. for greater than 75 MHz separation; 10 dB typ. For less than 75 MHz separation

Connector: 3.5 mm SMA compatible (53147A/53148A)
2.92 mm removable (53149A)

Power Meter Specifications

Frequency Range: 10 MHz to 50 GHz, sensor-dependent

Power Range: –70 dBm to +44 dBm, sensor-dependent

Power Sensors: 8480 series

Display Units: Watts, dBm

Resolution: 0.01 dB in log mode, 0.1% of full scale in linear mode

Accuracy

• Instrumentation: ± 0.02 dB or $\pm 0.5\%$

Power Reference

• Power Output: 1.00 mW. Factory set to $\pm 0.7\%$, traceable to U.S. National Institute of Standards and Technology.

DVM Specifications

Function: DC volts

Range: ± 50 Vdc

General

Display: Backlit LCD

Programming: GPIB and RS-232C, SCPI compatible

Math Functions

• Offset: Last reading and/or entered offset to reading for either power or frequency

• Averaging: 1 to 99 measurement running average

Save and Recall: Up to 9 complete instrument setups may be saved and later recalled

Power Requirements:

• 90 – 132 VAC; 50, 60, 400 Hz

• 216 – 264 VAC; 50, 60 Hz

• 11 – 18 VDC: battery option only

Battery (option):

• Type: VHS camcorder, sealed lead acid (2 each)

• Charge Time: 8 hours in unit

• Capacity: 2 hours typical

Timebase:

	TXCO (std)	Oven (opt)
Aging Rate	1×10^{-7} /mo	5×10^{-10} /day
Short Term (1 sec. avg.)	1×10^{-9}	2×10^{-10}
Temperature (0°C – 55°C)	$<1 \times 10^{-6}$	$<1 \times 10^{-8}$

Accessories Furnished: Power cord, 1.5 m power sensor cable (11730A), operating, programming and service manuals

Ordering Information

53147A 20 GHz Counter/Power Meter/DVM

53148A 26.5 GHz Counter/Power Meter/DVM

53149A 46 GHz Counter/Power Meter/DVM

5314xA-001 Oven Timebase

5314xA-002 Battery/DC Input

5314xA-007 Soft Carrying Case

5314xA-1CM Rackmount Kit

LCR & Resistance Meters

250

120 Hz/1 kHz, 1 kHz/1 MHz Capacitance Meter

4268A
4288A

- High speed measurement: 7 ms
- Accurate C-D testing: 0.075%, 0.0006
- Small cabinet size



4288A

- Constant test level for high value ceramic capacitor tests
- High speed measurement: 25 ms
- Quick contact check
- 9-bin comparator



4268A

4288A 1 kHz/1 MHz Capacitance Meter

The Agilent 4288A 1 kHz/1 MHz capacitance meter offers a high-speed with reliable measurements for capacitor testing in the production lines. The measurement capabilities of capacitance from low to middle values (up to 20 μF) can be realized with accurate measurements. The 4288A contributes improvements of the test throughput, while attaining excellent component quality for ceramic capacitor testing.

Specifications

Measurement Parameters: Cs, Cp, D, Q, Rs, Rp, G
Test Frequency: 1 kHz and 1 MHz (–1%, +1%, +2% frequency shift available)
Test Signal Level: 0.1 to 1 V_{rms}, $\pm 5\%$ in 0.1 V_{rms} steps
Measurement Range

Measurement Parameter	1 kHz	1 MHz
C	0.001 pF to 20.000 μF	0.00001 pF to 1500.00 pF
D	0.00001 to 9.99999	0.00001 to 9.99999

Measurement Time: 7 ms, 19 ms (typical)
Cable Length Compensation: 0 m, 1 m, 2 m
Comparator: 9 bin output to Handler Interface
Interface: Handler, GPIB, and Scanner interface

General Specifications

Operating Temperature/Humidity: 0°C to 45°C, $\leq 95\%$ RH @ 40°C
Power Requirements: 90 VAC to 132 VAC, 198 VAC to 264 VAC, 47 Hz to 66 Hz, 100 VA max.
Size: 100 mm H x 320 mm W x 300 mm D (4 in x 12.8 in x 12 in)
Weight: Approximately 3 kg (6.6 lb)

Key Literature

4288A Capacitance Meter 1 kHz/1 MHz Technical Overview, p/n 5980-2861EN

Ordering Information

4288A 1 kHz/1 MHz Capacitance Meter

Accessories

16034E SMD Test Fixture
16034G Small SMD Test Fixture (0603 [mm]/0201 [in] SMD)
16047A 4-Terminal Contact Lead Component Test Fixture
16047E 2-Terminal Contact Lead Component Test Fixture
16334A Tweezers Contact SMD Test Fixture
16048A Test Leads, BNC (1 m)
16048B Test Leads, SMC (1 m)
16048D Test Leads, BNC (2 m)

4268A 120 Hz/1 kHz Capacitance Meter

The 4268A capacitance meter offers the ability to test high value multi-layer ceramic capacitors at a constant large test signal level and at high speed. The constant test level feature allows the MLCCs to be tested, in compliance with IEC 384-10 standard, for up to 70 μF at 1 V rms at 1 kHz. 120 Hz measurement ensures the constant 1 V test signal for up to 600 μF . The 4268A can provide measured values along with comparator results within 25 ms, maximizing test throughput in MLCC production lines.

Major Specifications

Measurement parameters: Cs, Cp, D, Q, Rs, Rp, G
Test Frequency: 120 Hz and 1 kHz
Test Signal Level: 0.1 V to 1 V rms, $\pm 10\%$, in 0.01 V rms steps
Measurement Range

Measurement Parameter	120 Hz	1 kHz
C	0.001 nF to 9.9999 mF	0.0001 nF to 999.99 μF
D	0.0001 to 9.9999	0.0001 to 9.9999

Constant Test Level Range (Typical)

Test Voltage	120 Hz	1 kHz
0.5 V rms	C $\leq 1200 \mu\text{F}$	C $\leq 140 \mu\text{F}$
1 V rms	C $\leq 600 \mu\text{F}$	C $\leq 70 \mu\text{F}$

Measurement Time: 25 ms/43 ms/59 ms (typical)
Contact Check: Detects contact failure in 4T connection within 5 ms
Comparator: 9 bin output to Handler Interface
Interface: Handler, GPIB and optional scanner interface

General Specifications

Power Requirements: 90 V to 132 V or 198 V to 264 Vac, 47 to 66 Hz, 100 VA max.
Operating Temperature/Humidity: 0°C to 45°C, $\leq 95\%$ RH @ 40°C
Size: 100 mm H x 320 mm W x 450 mm D (3.94 in x 12.6 in x 17.72 in)
Weight: Approximately 5 kg (11 lb)

Key Literature

4268A Capacitance Meter Technical Overview, p/n 5967-5873E

Ordering Information

4268A 120 Hz/1 kHz Capacitance Meter

Options

4268A-001 Scanner Interface

Accessories

16034E SMD Test Fixture
16034G Small SMD Test Fixture (0603 [mm]/0201 [in] SMD)
16044A 4-Terminal Test Fixture for Chip Components
16334A Tweezers Contact SMD Test Fixture
16048A Test Leads, BNC (1 m)
16048B Test Leads, SMC (1 m)
16048D Test Leads, BNC (2 m)

- 1 MHz to 3 GHz, with 100 kHz steps
- Wide impedance measurement range from 200 mΩ to 3 kΩ
- Superior measurement repeatability at low test signal level
- 1% basic accuracy
- High-speed measurements: 9 ms



4287A with the 16196A

4287A RF LCR Meter

The Agilent 4287A RF LCR meter offers accurate, reliable and fast measurements from 1 MHz to 3 GHz to improve quality and throughput of electronic component testing in production lines. The 4287A employs the direct-current voltage-measurement technique, as opposed to the reflection-measurement technique, which yields accurate measurements over a wide impedance range.

High Throughput and Reliable Measurement

The 4287A is suitable for testing electronic components in the RF range. The 4287A's measurement speed is remarkably fast. In addition, the superior measurement repeatability at low test currents such as 100 μA provides a fast throughput since less averaging is required.

Simplified System Integration

The test head cable (1 m or 2 m by using an extension cable) can be easily connected closely to the tip of the device-under-test (of the component handler) without any increase in error. The built-in comparator function, a high-speed GPIB interface, and an handler interface, are available for simple integration with the component handler and PC. The enhanced comparator function makes sophisticated binning possible for multi-frequency or array chip testing.

Ease of Use

The 8.4-inch color display provides a clear view of measurement settings and results. The newly developed user interface makes operability easy and error-free. The built-in statistical analysis functions provide a process for monitoring test quality and efficiency. The LAN interface helps centralize production control and monitor. Also, a number of 7 mm SMD test fixtures can be used with the 4287A's furnished fixture stand and 3.5 mm-to-7 mm adapter, eliminating the need to build custom fixtures.

Specifications

(Refer to Data Sheet for complete specifications)

Measurement Parameters: |Z|, |Y|, θ-z (deg/rad), θ-y (deg/rad), G, B, Ls, Lp, Cs, Cp, Rs, Rp, Q, D (Four Meas. Parameters can be displayed at the same time.)

Test Frequency: 1 MHz to 3 GHz

Frequency Resolution: 100 kHz

Test Signal

• V: 4.47 mV to 502 mV @ f ≤ 1 GHz, 4.47 mV to 447 mV @ f > 1 GHz

• I: 0.0894 mA to 10 mA @ f ≤ 1 GHz, 0.0894 mA to 8.94 mA @ f > 1 GHz

Level Monition Function: Voltage, Current

Basic Z Accuracy: ±1.0%

Measurement Range: 200 mΩ to 3 kΩ (@ 1 MHz, accuracy ≤ 10%)

Measurement Time: 9 msec per point (max. speed)

Rdc Measurement: Available for contact check

Calibration: Open/Short/Load/Low Loss Capacitor

Compensation: Open/Short, Electrical Length

Mass Storage Function: 30 MB solid-state mass-storage or 2 GB HDD (Option Selection)

Interface: GPIB, LAN (10 Base-T/100 Base-Tx Automatic Selection), Handler Interface

Display: 8.4 inch color LCD display

General Specifications

Power Requirements: 90 V to 132 V, or 198 V to 264 V, 47 Hz to 63 Hz, 350 VA max.

Operating Temperature/Humidity: 5°C to 40°C/20% RH to 80% RH

Size: 234 mm H x 425 mm W x 445 mm D (9.36 in x 17 in x 17.8 in) (Main Frame)

Weight: 16 kg/0.3 kg (35.2 lb/.66 lb) (typical) (Main Frame/Test Head)

Key Literature

4287A RF LCR Meter Technical Overview, p/n 5968-5443E

4287A Technical Specifications, p/n 5968-5758E

LCR Meters, Impedance Analyzers, and Test Fixtures Selection Guide, p/n 5952-1430E

Ordering Information

4287A RF LCR Meter

Furnished Accessories: Test Head (1 m), CD-ROM (Manual), and Power Cable. (No test fixture is supplied with the 4287A)

Options

4287A-004 Add Working Standard Set

4287A-010 Hard-Disk Drive Mass Storage

4287A-011 Solid-State Mass Storage

4287A-020 Add Test Fixture Extension Cable Set

4287A-700 16195B Calibration Kit

4287A-710 Test Fixture Stand

4287A-720 3.5 mm – 7 mm Adapter

4287A-810 Add Keyboard

4287A-820 Add Mouse

Accessories

16190B Performance Test Kit

16195B 7 mm Coaxial Calibration Kit

16192A Parallel Electrode SMD Test Fixture (up to 2 GHz)

16194A High Temperature Test Fixture (up to 2 GHz)

16196A/B/C/D Parallel Electrode SMD Test Fixture

16197A Bottom Electrode SMD Test Fixture

16092A Test Fixture (up to 500 MHz)

16200B External DC Bias Adapter (up to 1 GHz)

- 0.1% basic accuracy
- 100 Hz, 120 Hz, 1 kHz, 10 kHz, 100 kHz test frequencies
- 20 mV to 1 V_{rms} in 5 mV_{rms} steps
- Test signal level monitor function
- High-speed measurement: 25 ms
- High-speed contact check
- Wide capacitance test range
- Transformer parameter measurements (optional)



4263B

4263B LCR Meter

The 4263B LCR meter is Agilent Technologies' most cost-effective low-end LCR meter, designed for both component evaluation on the production line and fundamental impedance testing for bench-top applications. The 4263B has five test frequencies that allow you to simulate testing under the correct conditions: 100 Hz, 120 Hz, 1 kHz, 10 kHz, and 100 kHz. An optional 20 kHz test frequency can be added to those five frequencies (4263B-002).

High-Speed Measurements

The 4263B can boost throughput with a measurement speed of 25 ms at any test frequency. This ability improves the throughput of electrolytic capacitor and transformer testing. The 4263B can check the contact condition between the test terminals and the device-under-test (DUT). This function ensures the reliability of PASS/FAIL testing with automatic handlers in production. The quick recovery system of the 4263B improves throughput. Normal operation is resumed the instant a faulty DUT is removed from the handler, so the handler can always be operated at its full speed.

Electrolytic Capacitor Measurements

The 4263B's accuracy and wide measurement range are the right tools to make precise measurements of electrolytic capacitors. Charged capacitors can discharge through the front end and destroy an instrument. The 4263B's front end is designed for protection and maintains test integrity.

Transformer Parameter Measurements

With the 4263B's ability to make turns ratio (N), mutual inductance (M), and dc resistance (DCR) measurements, data calculations and changing test setups are no longer time-consuming tasks (4263B-001). The flexible signal level setting and the voltage-and-current monitor function facilitate the use of the 4263B for level dependent DUTs, such as core inductors.

Specifications

(Refer to Technical Overview for complete specifications)

Measurement Functions

- Measurement Parameters: $|Z|$, $|Y|$, u , R , X , G , B , L , C , Q , D , ESR
 - 4263B-001: Add DCR (dc resistance), N (turns ratio), and M (mutual inductance) measurement
- Measurement Circuit Mode: Series and parallel

Mathematical Functions: Deviation and percent deviation

Test Cable Lengths: 0 m, 1 m, 2 m, 4 m (freq. = 100/120/1 kHz); 0 m, 1 m, 2 m (freq. = 10 k/20 kHz); 0 m, 1 m (freq. = 100 kHz)

Test Signal Information

- Test Frequency: 100 Hz, 120 Hz, 1 kHz, 10 kHz, and 100 kHz
 - 4263B-002: Add 20 kHz test frequency
- Frequency Accuracy: $\pm 0.01\%$ (freq. = 100 Hz, 1 kHz, 10 kHz, 20 kHz, 100 kHz), $\pm 1\%$ (freq. = 120 Hz)
- Output Impedance: 100 $\Omega \pm 10\%$, 25 $\Omega \pm 10\%$ ($\leq 1 \Omega$ range)
- AC Test Signal Level: 20 mV to 1 V_{rms} in 5 mV_{rms} steps
- Accuracy: $\pm(10\% + 10 \text{ mV})$
- Internal dc Bias
 - Level: 1.5 and 2 V; Accuracy: $\pm(5\% + 2 \text{ mV})$
- External dc Bias: 0 V to +2.5 V

Measurement Range

Parameter	Measurement Range
$ Z $, R , X	1 m Ω to 100 M Ω
$ Y $, G , B	10 nS to 1000 S
C	1 pF to 1 F
L	10 nH to 100 kH
D	0.0001 to 9.9999
Q	0.1 to 9999.9
θ	-180° to $+180^\circ$
DCR	1 m Ω to 100 M Ω
N	0.9 to 200 (unspecified)
L, M	1 μ H to 100 H (unspecified)
$\Delta\%$	-999.99% to $+999.99\%$

Measurement Accuracy: $\pm 0.1\%$ (basic) (for $|Z|$, R , X , $|Y|$, G , B , C , L)

Measurement Time

Mode	Time (typical)
SHORT	25 ms
MEDIUM	65 ms
LONG	500 ms

Test Signal Level Monitor: Voltage and current

Front-End Protection: Internal circuit protection when a charged capacitor is connected to the input terminals. The maximum capacitor voltage is:

$V_{\max} = \sqrt{(8/C)}$ (typical) @ $V_{\max} \leq 250 \text{ V}$; $V_{\max} = \sqrt{(2/C)}$ (typical) @ $V_{\max} \leq 1000 \text{ V}$, C is in Farads

Display Digits: 3, 4, or 5 (selectable)

Correction Function

OPEN/SHORT/LOAD: Eliminates measurement errors due to stray parasitic impedances in the test fixtures

Comparator Function: HIGH/IN/LOW for each primary measurement parameter and secondary measurement parameter

Contact Check Function: Contact failure between the test fixture and device can be detected. Additional time for contact check: 5 ms

Other Functions

- Save/Recall: Ten instrument setups can be saved/recalled from the internal nonvolatile memory
- Continuous Memory Capability: If the instrument is turned off, or if a power failure occurs, instrument settings (except dc bias on/off) are automatically memorized (≤ 72 hours at $23^\circ\text{C} \pm 5^\circ\text{C}$)
- GPIB Interface: All control settings, measured values, and comparator information
- Handler Interface: All output signals are negative-logic, optically isolated open collectors. Output signals include HIGH/IN/LOW, no contact, index, end of measurement, and alarm. Input signals include keylock and external trigger

General Specifications

Power Requirements: 90 to 132 V or 198 to 264 V, 47 to 66 Hz, 45 VA max.

Operating Temperature: 0°C to 45°C

Size: 100 mm H x 320 mm W x 300 mm D (3.94 in x 12.6 in x 11.81 in)

Weight: 4.5 kg (9.9 lb)

Key Literature

4263B LCR Meter Technical Overview, p/n 5964-6181E
Effective Electrolytic Capacitors Testing, p/n 5967-5378E
Effective Transformer/LF Coil Testing, p/n 5967-5377E
Effective Multi-tap Transformer Measurement using a Scanner and the Agilent 4263B LCR Meter, p/n 5091-6310E

Ordering Information

4263B LCR Meter

Options

- 4263B-001** Add Transformer Parameter Measurement Function
- 4263B-002** Add 20 kHz Test Frequency
- 4263B-ABA** US-English Localization
- 4263B-ABJ** Japan-Japanese Localization

Accessories

- 16060A** Transformer Test Fixture (4263B-001 Required)
- 16065C** External Bias Adapter (up to 40 Vdc)
- 16034G** Small SMD Test Fixture (0603 [mm]/0201 [in] SMD)
- 16044A** Kelvin Contact SMD Test Fixture
- 16047A** 4-Terminal Contact Lead Component Test Fixture
- 16047E** 2-Terminal Contact Lead Component Test Fixture
- 16334A** Tweezers Contact SMD Test Fixture

- **Wide measurement range:** $1 \times 10^3 \Omega$ to $1.6 \times 10^{16} \Omega$
- **Stable test fixtures:** resistivity cell, component test fixture
- **High-speed measurement:** 10 ms
- **Test sequence programming**
- **Resistivity calculations**
- **Grounded DUT measurement**



4339B

4339B High-Resistance Meter

The 4339B high-resistance meter is Agilent Technologies' most advanced tool for making precision high-resistance measurements.

Precise and Stable Measurement

The measurement range is from $1 \times 10^3 \Omega$ to $1.6 \times 10^{16} \Omega$, with a basic accuracy of 0.6%. This wide range allows accurate, high-resistance measurement of capacitors, relays, switches, connectors, materials, cables, and PC boards. The grounded device-under-test (DUT) measurement capability of the 4339B gives you the ability to evaluate cables and transformers under grounded conditions. The 16008B resistivity cell and the 16339A component test fixture are designed for stable and safe measurements of materials or components.

Simple Operation

The test-sequence program function allows you to control a series of resistance measurements in a sequence (charge-measure-discharge). You can set the charge time, measurement interval time, and number of measurements in a sequence through the front panel. The remaining time can be displayed when executing the sequence measurements. Surface resistivity (ps) and volume resistivity (pv) functions can be called to act upon measurement data. Calculated results are then automatically displayed, saving you time and effort.

High-Test Throughput

The 10 ms measurement time, 2 ms high-speed contact check function, built-in comparator, and GPIB/handler interfaces deliver high-speed test throughput for production environments.

Specifications

(Refer to Technical Overview for complete specifications)

Measurement Parameters: R (dc resistance), I (dc current), ps (surface resistivity), pv (volume resistivity)

Mathematical Functions: Deviation and percent deviation

Display Digits: 3, 4, or 5 (selectable)

Test Voltage: 0.1 Vdc to 1000 Vdc, 0.1 V steps @ 0.1 V to 200 V, 1 V steps @ 200 V to 1000 V

Voltage Accuracy: (0.16% + 100 mV) @ ≤ 200 V, (0.16% + 500 mV) @ > 200 V

Maximum Current: 10 mA @ ≤ 100 V, 5 mA @ ≤ 250 V, 2 mA @ ≤ 500 V, 1 mA @ ≤ 1 kV

Current Compliance Setting: 0.5 mA, 1 mA, 2 mA, 5 mA, 10 mA

Output Resistance: 1 k Ω \pm 10%

Input Resistance: 1 k Ω \pm 10%

Test Cable Lengths: 2 m maximum

Measurement Range/Accuracy

Parameter	Measurement Range	Basic Accuracy
I	60 fA to 100 μ A	$\pm 0.4\%$
R (Ω)	$1 \times 10^3 \Omega$ to 1.6×10^{16}	$\pm 0.6\%$

Measurement Time: Time interval from a trigger command to the end of measurement (EOM) signal output at the handler interface port (range: hold, display, off)

Mode	Time (typical)
SHORT	10 ms
MEDIUM	30 ms
LONG	390 ms

Correction Function

Zero OPEN: Eliminates measurement errors due to stray parasitic resistance in the test fixtures

Test Sequence Program: Controls a series of resistance measurements. Charge time, measurement interval time, and measurement number can be programmed

Comparator Function: HIGH/IN/LOW for the measurement parameter

Contact Check Function

Contact failure between the test fixture and device can be detected

• Available DUT Type: Capacitive DUTs only

– DUT Capacitance: ≥ 1 pF + 5% of residual stray capacitance

– Residual Stray Capacitance of the Fixture: ≤ 50 pF

• Additional Measurement Time for Contact Check: 2 ms

Other Functions

• **Save/Recall:** Ten instrument setups can be saved/recalled from the internal nonvolatile memory

• **Continuous Memory Capability:** If the instrument is turned off, or if a power failure occurs, instrument settings are automatically memorized (≤ 72 hours at $23^\circ\text{C} \pm 5^\circ\text{C}$)

• **GPIB Interface:** All control settings, measured values, and comparator information

• **Handler Interface:** All output signals are negative-logic, optically isolated open collectors. Output signals include: HIGH/IN/LOW, no contact, index, end of measurement, and alarm. Input signals include: high voltage off, keylock, and external trigger

General Specifications

Power Requirements: 90 V to 132 V or 198 V to 264 V, 47 Hz to 66 Hz, 45 VA max.

Operating Temperature: 0°C to 45°C

Size: 100 mm H x 320 mm W x 450 mm D (3.94 in x 12.6 in x 17.72 in)

Weight: 6.5 kg (14.3 lb)

Complies with 73/23/EEC and 92/68/EEC safety standard EN61010-1

Furnished Accessories

Operation manual, shunt connector, power cable (test fixtures and/or test leads must be ordered separately.)

Key Literature

4339B/4349B High Resistance Meters Technical Overview, p/n 5964-6182E

Insulation Resistance Measurement of Plate Type Materials, p/n 5968-3400E

Insulation Resistance Measurements of Electromechanical Components, p/n 5968-0325E

Agilent Solutions for Measuring Permittivity and Permeability with LCR Meters and Impedance Analyzers, p/n 5980-2862EN

Ordering Information

4339B High-Resistance Meter

4339B-ABA US-English Localization

4339B-ABJ Japan-Japanese Localization

16339A Component Test Fixture

16008B Resistivity Cell (50 mm Diameter Electrode)

16008B-001 Add 26/76 mm Diameter Electrodes

16008B-002 Add 26 mm Diameter Electrode

16117B Low-Noise Test Leads

16117B-001 Add Pin Probes

16117B-002 Add Soldering Sockets

16117B-003 Add Alligator Clips

16117C Low-Noise Test Leads (1 m, connectors)

16118A Tweezer Test Fixture

LCR & Resistance Meters

254

Precision LCR Meter

E4980A

- 20 Hz to 2 MHz, with over 45001 test frequencies
- 0.05% basic accuracy, 7-digit resolution
- Fast measurement speed: 5.6 ms/meas.
- Constant V or I test signal
- 20 V_{rms} level, and DC source option (E4980A-001)
- 40 A dc with 42841A
- List sweep measurement capability, max 201 points



The Agilent E4980A Precision LCR Meter offers the highest accuracy and repeatability from 20 Hz to 2 MHz, and supports LAN, USB and GPIB PC connectivity. Unlike competing LCRs, the E4980A offers fast measurement speed and outstanding performance at both low and high impedance. Compared with Agilent's 4284A LCR, the E4980A provides measurements 5 times faster, a modern PC interface, compact size and additional features to further enhance your design and test productivity.

Specifications

(Refer to Data Sheet for complete specifications)
Measurement Parameters: Z, Y, R, X, G, B, L, C, D, Q, ESR, (Rdc, Vdc, Idc, option E4980-001 is required); Deviation and % deviation
Measurement Circuit Modes: Series and parallel
Ranging: Auto and manual
Trigger: Internal, external, manual, and bus (GPIB/USB/LAN)
Delay Time: 0 s to 100 s in 100 us steps, 100 s to 999 s in 1 ms steps
Measurement Terminals: Four-terminal pair
Test Cable Length: 0, 1, 2 and 4 m
Integration Time: Short, medium, and long
Averaging: 1 to 256, programmable
Test Signal: 20 Hz to 2 MHz $\pm 0.01\%$, 45001 selectable frequencies
Test Signal Modes
Normal: Programs selected voltage or current at the measurement terminals open or shorted, respectively, and not at the device-under-test
Constant: Maintains selected voltage or current at the device-under-test independent of changes in the device's impedance

Test Signal Levels (rms)	Normal/Constant
E4980A Standard	0 V to 2 V, 0 A to 20 mA
E4980A-001	0 V to 20 V (test frequency ≤ 1 MHz), 0 V to 15 V (test frequency > 1 MHz), 0 A to 100 mA

DC Bias

- E4980A Standard: 0 V, 1.5 V and 2 V
- E4980A-001: 0 V to ± 40 V

DC Source (E4980A-001 only): -10 V to 10 V

Measurement Display Range

Parameter	Range
Z, R, X	1.000000 a Ω to 999.9999 E Ω
Y, G, B	1.000000 aS to 999.99999 ES
C	1.000000 aF to 999.9999 EF
L	1.000000 aH to 999.9999 EH
D	0.000001 to 9.999999
Q	0.01 to 999999.99
Vdc	1.000000 aV to 999.9999 EV
Idc	1.000000 aA to 999.9999 EA
θ	-180.0000° to 180.0000°
$\Delta\%$	-999.9999% to 999.9999%

Basic Measurement Accuracy

	Z, C, L	D
E4980A	0.05%	0.0005 (relative accuracy)

@23°C $\pm 5^\circ$ C, after OPEN and SHORT correction

Supplemental Characteristics

Measurement Time (at 1 MHz): Typical measurement time from the trigger command to the end of measurement (EOM) output at the handler interface connector

SHORT	5.6 ms
MEDIUM	88 ms
LONG	220 ms

E4980A-001 DC Bias Current Output: 100 mA max.

Display

TFT LCD: Displays measured values, control settings, comparator limits and decisions, list sweep tables, self-test messages, and annunciations.

Correction Function

OPEN/SHORT/LOAD: Eliminates measurement errors due to the test fixture's stray parasitic impedance.

List Sweep Function

A maximum of 201 frequencies or test signal levels can be programmed. Single or sequential testing can be performed. When E4980A-001 is installed, dc bias or dc source testing can also be performed.

Comparator

Ten-bin sorting for the primary measurement parameter. IN/OUT for the secondary measurement parameter.

Bin Count: 0 to 999999

List Sweep Comparator: HIGH/IN/LOW decision output for each measurement point in the list sweep table

Other Functions

- **STORE/LOAD:** Ten instrument setups can be stored/loaded from the internal non-volatile memory. Ten additional setups can also be stored/loaded from a USB memory.
- **Remote control:** GPIB/USB/LAN All instrument control settings, measured values, comparator limits, list sweep table, and self-test results.
- **Memory:** The memory buffer can store a maximum of 201 measurement results and output the data over GPIB/USB/LAN, ASCII, and 64-bit binary data formats.

General Specifications

Power Requirements: 90 VAC to 264 VAC, 47 to 63 Hz

Power Consumption: 150 VA max.

Operating Temperature and Humidity

0°C to 55°C, 15% to 85% RH at 40°C

Size: 105 mm H x 375 mm W x 390 mm D (4.13 in x 14.77 in x 15.36 in)

Weight: Approximately 15 kg (11.7 lb)

Accessories

42841A Bias Current Source

- Bias Current Output: (23°C ± 5°C); 0.01 A to 20.0 A
- Basic Impedance Accuracy: 1% when used with the E4980A (1 kHz to 1 MHz)
- Interface: Custom, directly controllable by the E4980A with E4980A-002

42842A/B Bias Current Test Fixture

Used with the E4980A and 42841A for high dc bias current measurements:

- 42842A: 20 A max.
- 42842B: 40 A max.

42843A Bias Current Cable

Used with the E4980A, 42841A (2 units), and 42842B for 40 A maximum applications (necessary for $I_{dc} > 20$ A)

Key Literature & Web Link

E4980A Precision LCR Meter 20 Hz to 2 MHz Brochure, p/n 5989-4235EN

E4980A Precision LCR Meter Data Sheet, p/n 5989-4435EN

LCR Meters, Impedance Analyzers and Test Fixtures Selection Guide, p/n 5952-1430E

www.agilent.com/find/E4980A

Ordering Information

E4980A Precision LCR Meter, 20 Hz to 2 MHz

E4980A-001 Power and DC Bias Enhancement

E4980A-710 No Interface

E4980A-002 Bias Current Interface

E4980A-201 Handler Interface

E4980A-301 Scanner Interface

E4980A-ABA Add Hardcopy User's Guide

E4980A-ABJ Add Hardcopy Users Guide

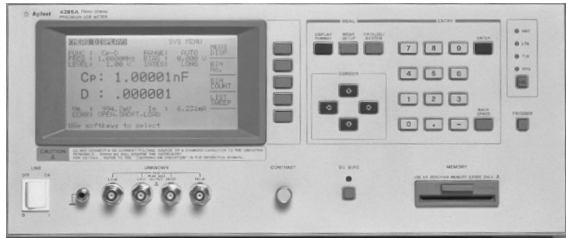
E4980A-1A7 Add ISO 17025 Compliant

E4980A-A6J ANSI Z540 Compliant Calibration

E4980A-1CM Add Rack Mount Kit

E4980A
4285A

- 75 kHz to 30 MHz in 100 Hz steps
- 0.1% basic accuracy
- High-speed measurements: 30 ms/meas.
- Constant V or I test signal level
- 10 A dc with 42841A
- List sweep measurement capability



4285A

4285A Precision LCR Meter

The Agilent 4285A precision LCR meters is cost-effective solution for component and material measurement. It can be used to improve component quality by providing an accurate, high-throughput test solution. For demanding RF component tests, the 4285A offers a higher test-frequency range, from 75 kHz to 30 MHz. Whether in research and development, production, quality assurance, or incoming inspection, the 4285A will meet all of your LCR meter test and measurement requirements.

Specifications

(Refer to Data Sheet for complete specifications)

Measurement Parameters: Z , $|Y|$, θ , R, X, G, B, L, C, D, Q, ESR; Deviation and % deviation

Measurement Circuit Modes: Series and parallel

Ranging: Auto and manual

Trigger: Internal, external, manual, and bus (GPIO)

Delay Time: 0 s to 60.000 s in 1 ms steps

Measurement Terminals: Four-terminal pair

Test Cable Length: 0, 1 and 2 m

Integration Time: Short, medium, and long

Averaging: 1 to 256, programmable

Test Signal: 75 kHz to 30 MHz \pm 0.01%, 100 Hz steps

Test Signal Modes

Normal: Programs selected voltage or current at the measurement terminals open or shorted, respectively, and not at the device-under-test

Constant: Maintains selected voltage or current at the device-under-test independent of changes in the device's impedance

Test Signal Levels (rms)	Normal	Constant
4285A	5 mV to 2 V, 200 μ A to 20 mA	10 mV to 1 V, 100 μ A to 20 mA

DC Bias:

4285A-001: 0 V to \pm 40 V

Measurement Display Range

Parameter	Range
Z , R, X	0.01 m Ω to 99.9999 M Ω
$ Y $, G, B	0.01 nS to 99.9999 S
C	0.01 fF to 999.999 μ F
L	0.001 nH to 99.9999 H
D	0.000001 to 9.99999
Q	0.01 to 99999.9
θ	-180.000° to 180.000°
$\Delta\%$	-999.999% to 999.999%

Basic Measurement Accuracy

	Z , C, L	D
4285A	0.1%	0.001

@ 23°C \pm 5°C, after OPEN and SHORT correction

Supplemental Characteristics

Measurement Time: Typical measurement time from the trigger command to the end of measurement (EOM) output at the handler interface connector

SHORT	30 ms
MEDIUM	65 ms
LONG	200 ms

4285A-001 DC Bias Current Output: 100 mA max.

Display

LCD Dot-matrix Display: Displays measured values, control settings, comparator limits and decisions, list sweep tables, self-test messages, and annunciations.

Correction Function

OPEN/SHORT/LOAD: Eliminates measurement errors due to the test fixture's stray parasitic impedance.

List Sweep Function

A maximum of ten frequencies or test signal levels can be programmed. Single or sequential testing can be performed. When 4285A-001 is installed, dc voltage bias testing can also be performed.

Comparator

Ten-bin sorting for the primary measurement parameter. IN/OUT for the secondary measurement parameter.

Bin Count: 0 to 999999

List Sweep Comparator: HIGH/IN/LOW decision output for each measurement point in the list sweep table

Other Functions

- **STORE/LOAD:** Ten instrument setups can be stored/loaded from the internal non-volatile memory. Ten additional setups can also be stored/loaded from a memory card.
- **PIB:** All instrument control settings, measured values, comparator limits, list sweep table, and self-test results.
- **Memory:** The memory buffer can store a maximum of 128 measurement results and output the data over GPIB, ASCII, and 64-bit binary data formats.

General Specifications

Power Requirements: 100/120/220 V \pm 10%, 240 V 5%/–10%, 47 to 66 Hz

Power Consumption: 200 VA max.

Operating Temperature and Humidity: 0°C to 55°C, \leq 95% RH at 40°C

Size: 177 mm H x 426 mm W x 498 mm D (6.97 in x 16.77 in x 19.61 in)

Weight: Approximately 16 kg (35.2 lb)

Accessories

42841A Bias Current Source

- Bias Current Output: (23°C \pm 5°C); 0.01 A to 20.0 A
- Basic Impedance Accuracy: 1% when used with the 4285A (1 kHz to 1 MHz)
- Interface: Custom, directly controllable by the 4285A with 4285A-002

42842C Bias Current Test Fixture

Used with the 4285A and 42841A for high dc bias current measurement. 10 A max.

Key Literature

4285A Technical Overview, p/n 5952-1431

4285A Data Sheet, p/n 5963-5395E

LCR Meters, Impedance Analyzers and Test Fixtures Selection Guide, p/n 5952-1430E

Ordering Information

4285A Precision LCR Meter

4285A-700 No DC Bias

4285A-001 DC Bias

4285A-002¹ Accessory Control Interface

4285A-004 Memory Card

4285A-201 General Purpose Handler Interface

4285A-202 Handler Interface

4285A-301 Scanner Interface

4285A-710 Blank Panel

42841A Bias Current Source

42842C Bias Current Test Fixture (10 A max.)

42842C-001 SMD Test Fixture (42842C only)

¹ 4285A-001 and 4285A-002 do not operate simultaneously.

- Low and selectable test signal current: 1 μ A to 10 mA
- Wide measurement range: 10 $\mu\Omega$ to 100 k Ω
- 10 $\mu\Omega$ resolution
- Contact check function
- 1 kHz ac measurement
- High-speed measurement: 34 ms
- Built-in comparator
- Auto-measurement mode



4338B

4338B Milliohmmeter

The 4338B milliohmmeter is a precise, reliable, high-speed test tool for measurements of low resistance.

Precise, Low-Resistance Measurement

Contact failure of electromechanical components in a low-current circuit is a key issue for component reliability. The 4338B offers selectable low ac test signals (1 μ A to 10 mA). Users can now characterize low resistances of electromechanical components under low-current conditions. A high resolution of 10 $\mu\Omega$ allows you to determine the slightest differences in contact resistance testing of relays, switches, connectors, PC board traces and cables. The 1 kHz test signal eliminates potential errors introduced by thermoelectric effects on the device-under-test (DUT) contacts. The 1 kHz ac test signal is the best solution to evaluate the internal resistance of batteries, because it avoids dc energy consumption.

High-Speed Measurements

The high-speed (34 ms), built-in comparator and GPIB/handler interfaces make it possible to construct a measurement system using an automatic handler and external computer to minimize production test time.

Auto-Measurement Mode

When performing gross continuity testing where the test signal level is not a significant factor in the test, the auto-measurement function allows the instrument to select an appropriate test signal and measurement range setting.

Specifications

(Refer to Technical Overview for complete specifications)

Measurement Function

Measurement Parameters: R (ac resistance), X (reactance), L (inductance), Z (impedance), θ (phase [°])

Combinations: R, R-X, R-L, Z, - θ (series mode only)

Mathematical Functions: Deviation and percent deviation

Display Digits: 3, 4, or 5 (selectable)

Test Signal Characteristics

- Test Frequency: 1 kHz
- Frequency Accuracy: $\pm 0.1\%$
- Test Signal Level: 1 μ A, 10 μ A, 100 μ A, 1 mA, 10 mA rms
- Level Accuracy: $\pm(10\% + 0.2 \mu\text{A})$
- Maximum Voltage Across Sample: 20 mV peak in any case

Measurement Range

Parameter	Measurement Range
R	10 $\mu\Omega$ to 100 k Ω
X, Z	10 $\mu\Omega$ to 100 k Ω (typical)
L	10 nH to 10 H (typical)
θ	-180° to +180° (typical)

Measurement Accuracy: $\pm 0.4\%$ Basic for R

Measurement Time: Time interval from a trigger command to the end of measurement (EOM) signal output at the handler interface port

Mode	Time (typical)
SHORT	34 ms
MEDIUM	70 ms
LONG	900 ms

Correction Function

Zero SHORT: Eliminates measurement errors due to parasitic impedances in the test fixture

Comparator Function

HIGH/IN/LOW for each primary measurement parameter and the secondary measurement parameter

Contact Check Function

Contact failure between the test fixture and device can be detected

Other Functions

- Superimposed dc: ± 42 Vdc maximum may be present on measurement terminals
- Save/Recall: Ten instrument setups can be saved/recalled from the internal nonvolatile memory
- Continuous Memory Capability: If the instrument is turned off, or if a power failure occurs, instrument settings are automatically memorized (≤ 72 hours at $23^\circ\text{C} \pm 5^\circ\text{C}$)
- GPIB Interface: All control settings, measured values, and comparator information
- Handler Interface: All output signals are negative-logic, optically isolated open collectors
- Output Signals Include: HIGH/IN/LOW, index, end of measurement, and alarm. Input signals are keylock and external trigger

General Specifications

Power Requirements: 90 V to 132 V or 198 V to 264 V, 47 Hz to 66 Hz, 45 VA max.

Operating Temperature: 0°C to 45°C

Size: 100 mm H x 320 mm W x 300 mm D (3.94 in x 12.6 in x 11.81 in)

Weight: 4.5 kg (9.9 lb)

Key Literature

4338B Milliohmmeter Technical Overview, p/n 5964-6183E

Furnished Accessories

Operation manual, power cable (mating cable and test leads, or 16338A test lead set, must be ordered separately)

Ordering Information

4338B Milliohmmeter

Furnished Accessories: CD-ROM (manual), power cable (mating cable and test leads, or 16338A test lead kit, must be ordered separately)

Options

4338B-ABA US-English Localization

4338B-ABJ Japan-Japanese Localization

Accessories

16338A Test Lead Kit

The 16338A contains the following accessories:

- Kelvin Clip Lead (large, 2 ea)
- Kelvin IC Clip Lead (red, 1 ea)
- Kelvin IC Clip Lead (black, 1 ea)
- Pin-Type Probe Lead (2 ea)
- Alligator Clip Leads (red, 1 ea)
- Alligator Clip Leads (black, 1 ea)
- Mating Cable (1 ea)



Component Measurement

Today's electronic components are designed for higher performance, while being reduced in size, power consumption, and cost. Efficient and accurate component characterization, design evaluation, and manufacturing test are critical to the success of component users and suppliers. Agilent Technologies offers the industry's broadest line of component test instruments for passive as well as active components. The products in this section are designed to measure fundamental impedance-related parameters of electronic components and materials.

Impedance Measuring Instruments

Impedance measuring instruments can be divided into two general categories: LCR meters and impedance analyzers. LCR meters primarily measure inductance, capacitance, and resistance of the test device at spot frequencies. Impedance analyzers, in addition to all the functions of the LCR meter, measure impedance, phase, and

sometimes transmission parameters. These analyzers have extended frequency range, a synthesized source, swept frequency capability, and excellent frequency resolution. Combination network/spectrum/impedance analyzers offer the benefits of impedance analysis as well as vector-network and spectrum analysis. See the Selection Guides that follow for general instrument capabilities. For higher frequencies (above 3 GHz) in a 50 Ω environment, a dedicated vector-network analyzer is the best solution for impedance measurements. See Network Analyzers.

Selecting a test fixture is as important as selecting the right instrument. Agilent offers a wide range of accessories for axial, radial, and SMD chip devices. See page 261.

Materials Measurements

Materials have two properties that determine how they interact with electromagnetic fields:

- Permittivity (ϵ) or dielectric constant for electric fields

- Permeability (μ) for magnetic fields

Permittivity ($\epsilon^* = \epsilon' - j\epsilon''$) and permeability ($\mu^* = \mu' - j\mu''$) are complex values. The real part (ϵ' or μ') is a measure of how much energy is stored in a material. The imaginary part (ϵ'' or μ'') is a measure of how much energy is lost in a material. These properties are not constant and may change with frequency or temperature, for example. Accurate measurements of these material properties during characterization or inspection help to achieve the best performance for a given application while shortening design cycles and minimizing scrap.

A materials measurement system consists of an instrument, a fixture to hold the material, and software or firmware to calculate complex permittivity or permeability values and display the results. For material testing applications, Agilent currently offers three types of solutions: LCR meter-based, impedance analyzer-based, and network analyzer-based systems.

Agilent offers fixture accessories based on the open-ended coaxial probe, the transmission line measurement, the parallel plate capacitance, and the inductor impedance technique. These choices allow you to best match the fixture, frequency range, and measurement technique with your material's physical and electrical test requirements. The chart of material test applications and solutions is shown in the next page 260.

Signal Source Device Test

Agilent provides an excellent performance analyzer for evaluating nearly all types of RF and microwave signal source device such as crystal oscillators, VCOs, DROs, RFICs, and PLL synthesizers. The Agilent Signal Source Analyzer is the single instrument solution enabling phase noise, frequency, power, DC current, and frequency/phase/power over time measurements. See page 268 for the Agilent Signal Source Analyzer.

For specific applications such as resonator and filter measurements, see page 163 and 164.

Impedance Analyzer Selection Guide

Model	Frequency Range	Impedance Range/Other	Additional Information	Page
4294A	40 Hz to 110 MHz	25 m Ω to 40 M Ω *	Color display, equivalent circuit analysis, IBASIC, LAN I/F, SMD fixtures	266
4395A**	100 kHz to 500 MHz	2 Ω to 5 k Ω * S-parameters, gain-phase	Color display, equivalent circuit analysis, SMD fixture vector-network and spectrum analysis, IBASIC	164
4396B**	100 kHz to 1.8 GHz	2 Ω to 5 k Ω * S-parameters, gain-phase	Color display, equivalent circuit analysis, SMD fixture vector-network and spectrum analysis, IBASIC	166
E4991A	1 MHz to 3 GHz	200 m Ω to 20 k Ω	Color display, VBA, SMD fixtures, equivalent circuit analysis, material, LAN I/F, temperature characteristic measurement	262

* 10% accuracy range

** with 4395A/4396B-010 and 43961A

Component Test Instruments

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Overview (cont.)

Overview

LCR and Resistance Meter Selection Guide

Model	Frequency Range	Impedance Range/ Other	Additional Information	Page
4263B	100 Hz to 100 kHz (5 test frequencies)	1 mΩ to 100 MΩ	Optional transformer test	252
4268A	120 Hz/1 kHz	0.0001 nF to 10 mF	High-value ceramic capacitor test	250
E4980A	20 Hz to 2 MHz	0.001 fΩ to 999.9999 TΩ	42841A for high-current dc bias	254
4285A	75 kHz to 30 MHz (100 Hz steps)	0.01 mΩ to 100 MΩ	42841A for high-current dc bias	256
4287A	1 MHz to 3 GHz (100 kHz steps)	200 mΩ to 3 kΩ	Higher-accuracy, higher-speed RF LCR meter	251
4288A	1 kHz/1 MHz	0.00001 pF to 20 μF	High-speed capacitor test	250
4339B	dc	1 kΩ to 1.6×10^{16} Ω	High-resistance meter, volume and surface resistivity, current	253
4338B	1 kHz test signal	10 μΩ to 100 kΩ	Milliohm meter	258

Material Test Applications and Solutions

	DC Resistivity Cell (16008B) Page 253	Dielectric Test Fixture (16451B) Page 265	Liquid Dielectric Test Fixture (16452A) Page 265	Dielectric and Magnetic Test Fixtures (16453A) (16454A) Page 264	Dielectric Probe System (85070M)	Agilent Material Measurement Software (85071B)
Absorber					•	•
Ceramic	•	•		•	•	
Fermentation					•	
Film (thin)		•		•		
Food					•	
Gel, semi-solid					•	
Liquid			•		•	
Loss		•	•	•	•	
Permeability				•		•
Permittivity (dielectrics)		•	•	•	•	•
Plastic	•	•		•	•	
Powder					•	
Printed circuit board		•		•		
Resistivity	•					
Rubber	•	•		•	•	
Solid	•	•		•	•	
Substrate	•	•		•	•	

Signal Source Device Test

Model	Frequency Range	Brief Description	Page
Signal Source Analyzer E5052B	10 MHz to 7 GHz	Single instrument solution provides a complete set of signal source measurements including phase noise, frequency, power, DC current, and frequency/phase/power transient.	268
Resonator/Filter Test E5100A	10 kHz to 180/300 MHz	Network analyzer best fitted for production line especially for resonator and filter manufacturer with fast measurement speed, low noise floor and powerful dedicated commands.	163



16047E



16034G



16044A



16089E



16196A/B/C/D

Test Accessories/Fixtures

			4263B	4268A	4285A	4287A	4288A	4294A	4294A with 42942A	4395A with 4395A-010 and 43961A	4396B with 4396B-010 and 43961A	E4980A	E4991A
16034E	SMD/Chip Test Fixtures	DC – 40 MHz	•	•	•	•	•	•				•	
16034G	SMD/Chip Test Fixture, Small	DC – 110 MHz	•	•	•	•	•	•				•	
16034H	SMD/Chip Test Fixture, General	DC – 110 MHz	•	•	•	•	•	•				•	
16044A	SMD/Chip Test Fixture, Kelvin Contacts, 10 MHz	DC – 10 MHz	•	•	•	•	•	•				•	
16047A	Axial and Radial Test Fixture	DC – 13 MHz	•	•	•	•	•	•				•	
16047D	Axial and Radial Test Fixture	DC – 40 MHz	•	•	•	•	•	•				•	
16047E	Axial and Radial Test Fixture, 110 MHz	DC – 110 MHz	•	•	•	•	•	•				•	
16048A	One Meter Test Leads, BNC	DC – 30 MHz	•	•	•	•	•	•				•	
16048B	One Meter Test Leads, SMC	DC – 30 MHz	•	•	•	•	•	•				•	
16048D	Two Meter Test Leads, BNC	DC – 30 MHz	•	•	•	•	•	•				•	
16048E	Four Meter Test Leads, BNC	DC – 2 MHz	•									•	
16048G	One Meter Test Leads, BNC, 110 MHz	DC – 110 MHz						•					
16048H	Two Meter Test Leads, BNC, 110 MHz	DC – 110 MHz						•					
16060A	Transformer Test Fixture	DC – 100 kHz	•										
16065A	Ext. Voltage Bias with Safety Cover (≤ 200 Vdc)	50 Hz – 2 MHz	•	•	•		•	•				•	
16065C	External Bias Adapter (≤ 40 Vdc)	50 Hz – 1 MHz	•	•			•						
16085B	Four-terminal Pair to 7-mm Adapter	DC – 40 MHz	•	•	•	•	•	•				•	
16089A/B/C/D/E	Kelvin Clip Leads	5 Hz – 100 kHz	•	•	•	•	•	•				•	
16092A	RF Spring Clip: Axial, Radial and SMD	DC – 500 MHz	*1	*1	*1	*4	*1		•	•	•	*1	•
16095A	LF Impedance Probe	DC – 13 MHz	*3	*3	*3		*3					*3	
16192A	Parallel Electrode SMD Test Fixture	DC – 2 GHz	*1	*1	*1	*4	*1		•	•	•	*1	•
16194A	High Temperature Component Text Fixture	DC – 2 GHz	*1	*1	*1	*4	*1		•	•	•	*1	•
16196A/B/C/D	Parallel Electrode SMD Test Fixture	DC – 3 GHz	*1	*1	*1	*4	*1		•	•	•	*1	•
16197A	Bottom Electrode SMD Test Fixture	DC – 3 GHz	*1	*1	*1	*4	*1		•	•	•	*1	•
16200B	External DC Bias Adapter	1 MHz – 1 GHz				*4			•	•	•		•
16316A	One Terminal (BNC) Balun (100 Ω bal. to 50 Ω unbal.)	100 Hz – 10 MHz								•	•		
16317A	One Terminal (BNC) Balun (600 Ω bal. to 50 Ω unbal.)	100 Hz – 3 MHz								•	•		
16334A	SMD/Chip Tweezers	DC – 15 MHz	•	•	•		•	•				•	
16451B	Dielectric Material Test Fixture	5 Hz – 30 MHz	•	•	•		•	•				•	
16452A	Liquid Test Fixture	20 Hz – 30 MHz			•		•					•	
16453A	Dielectric Material Test Fixture	1 MHz – 1 GHz											•
16454A	Dielectric Material Test Fixture	1 kHz – 1 GHz							•				•
42842A/B	High Bias Current 20 A/40 A Test Fixture	20 Hz – 2 MHz										•	
42842C	High Bias Current 10 A Test Fixture	75 kHz – 30 MHz			•								
42941A	Impedance Probe Kit	DC – 110 MHz						•					
42942A	Four-terminal Pair to 7-mm Adapter	DC – 110 MHz						•					

Note : Refer to the accessory descriptions for frequency and operational limits.

¹ Compatible when used in conjunction with 16085B.

³ Do not connect the ground lead to the instrument.

² 7-mm cable is required.

⁴ 3.5-mm(m) to 7-mm Adapter is required.

Impedance Measuring Instruments

262

RF Impedance/Material Analyzer, 1 MHz to 3 GHz

E4991A

- Basic accuracy $\pm 0.8\%$
- 3 GHz impedance direct read-out
- Windows-styled user interface
- Sweep parameters (frequency, ac level, dc bias)
- Built-in VBA programming function
- Various test fixture for components
- Data transfer through the LAN interface
- Direct read-out permittivity, permeability (Option)
- Temperature characteristic measurement



E4991A

E4991A RF Impedance/Material Analyzer

The new Agilent E4991A RF impedance/material analyzer offers ultimate impedance measurement performance and powerful built-in analysis function. It will provide innovations in R&D of components and circuit designers who evaluate components in the range of 3 GHz. The E4991A uses an RF-IV technique, as opposed to the reflection measurement technique, for more accurate impedance measurement over wide impedance range. Basic impedance accuracy is $\pm 0.8\%$. High Q accuracy enables low-loss component analysis. The internal synthesizer sweeps frequency from 1 MHz to 3 GHz with 1 mHz resolution.

Versatile Analysis

The E4991A enables display up to 3 scalar and 2 complex parameters. Engineer can easily observe the various impedance parameters. The list-sweep function improves test throughput by segmenting the sweep includes only necessary measurement frequencies. Test signal level ranges enable device evaluation under actual operating conditions. The DC bias, AC signal level swept measurement, and the monitor of test signal functions are available to the E4991A.

Internal VBA programming function is also useful for R&D in order to analyze component or material by using own analysis method. Furthermore, the built-in Equivalent Circuit Analysis Function automatically calculates the circuit constant values of five circuit models. These functions will drastically improve engineering productivity.

Material Evaluation

The E4991A provides the total dielectric/magnetic material measurement solutions in wide frequency range (1 MHz to 1 GHz). See page 264 for more information.

Ease of Use

The 8.4-inch color display and Windows-styled user interface is employed in the E4991A. Color display brings a clear view of measurement settings and results. Windows-styled menu gives you easy access to advanced features. The standard TCP/IP-compliant LAN interface realizes seamless connectivity with PC. With LAN capability, PC can directly read out measurement data from E4991A. It helps you to make documentation and share your test results with others.

Test Fixtures

Various test fixtures are available for the E4991A. Especially the 16196x family, Parallel electrode SMD test fixture, and 16197A, Bottom electrode SMD test fixture, are the new test fixtures for surface mount devices (SMDs) component. These fixtures are covering 3 GHz frequency range. (See page 263 for more information.) The E4991A replaces existing RF impedance material analyzer, 4291B. The E4991A is succeeding most of fundamental features of 4291B and additional new features are significantly improved usability.

Temperature Characteristic Test Solution is Ready

The E4991A provides a temperature characteristic measurement solution for components and materials. This solution provides highly accurate temperature characteristic analysis capability within the wide temperature range from -55°C to $+150^{\circ}\text{C}$. The E4991A covers the wide impedance measurement range with a single test head. Also, the temperature drift compensation function enables you to perform open/short compensation at pre-defined temperature points so that temperature drift error can be drastically reduced.

Accurate Impedance Measurement with Probe Station

When connecting the E4991A to a probe station, accuracy degradation caused by port extension and improper calibration, is a significant concern. E4991A-010, Probe Station Connection Kit, provides all necessary parts in one option and solves this problem. This option includes extension cables, a connecting plate, and detailed installation procedures. Cascade Microtech is an Agilent channel partner and they provide RF probe stations. By combining E4991A-010 with a Cascade Microtech RF probe station, you can create an accurate on-wafer characterization system.

Specifications

Measurement Parameters:

$|Z|, \theta_Z, |Y|, \theta_Y, R, X, G, B, C_s, C_p, L_s, L_p, R_p, R_s, D, Q, |\Gamma|, \theta_r, \Gamma_x, \Gamma_y$

Material Parameters: $|\epsilon_r|, \epsilon_r', \epsilon_r'', |\mu_r|, \mu_r', \mu_r'', \tan \delta$

Basic Impedance Accuracy: 0.8%

Operating Frequency: 1 MHz to 3 GHz

Frequency Resolution: 1 mHz

Frequency Reference Accuracy: $< \pm 10$ ppm @ $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$

Precision Frequency Reference: (E4991A-1D5)

Accuracy: $< \pm 1$ Vppm/year @ 0°C to 55°C , referenced to 23°C

Source Characteristics

OSC Level:

4.47 mV to 477 mV_{rms}

89.4 μA to 8.94 mA_{rms}

Display Level Unit: V, I, dBm

Level Monitor Function: Voltage, Current

Connector: 7 mm

Output Impedance (nominal value): 50 Ω

DC Bias (E4991A-001)

DC Level: 0 V to ± 40 V, 0 mA to ± 50 mA

DC Level Monitor Function: Voltage, Current

Sweep Characteristics

Sweep Parameter: Frequency, AC signal level, DC bias level

Calibration/Compensation

Calibration: Open/Short/Load/Low-loss capacitor

Compensation: Open/Short, Port extension, Fixture electrical length

Key Specifications of Test Fixtures

Type of Fixture	Operating Freq. (typ.)	Operating Temperature	DUT Size (L x W: mm)
16192A	DC to 2 GHz	-55°C to $+85^{\circ}\text{C}$	1.0 to 20.0
16194A	DC to 2 GHz	-55°C to $+200^{\circ}\text{C}$	2.0 to 15.0
16196A	DC to 3 GHz	-55°C to $+85^{\circ}\text{C}$	1.6 x 1.8 only
16196B	DC to 3 GHz	-55°C to $+85^{\circ}\text{C}$	1.0 x 0.5 only
16196C	DC to 3 GHz	-55°C to $+85^{\circ}\text{C}$	0.6 x 0.3 only
16196D	DC to 3 GHz	-55°C to $+85^{\circ}\text{C}$	0.4 x 0.2 only
16197A	DC to 3 GHz	-55°C to $+85^{\circ}\text{C}$	0.6 to 3.2

Display

CRT: 8.4-inch color LCD display

Number of Display Channel: 1

Format: Single, dual, active + memory, graphic, and tabular

Storage/Programming functions

Type: Built-in 3.5-inch floppy disk drive, Internal HDD

Disk Format: DOS

Programming: VBA (Built-in)

Input and Output Characteristics

External Reference Input: 10 MHz \pm 100 Hz (typical)

Internal Reference Output: 10 MHz nominal

Reference Oven Output (E4991A-1D5): 10 MHz nominal

External Trigger Input: BNC female, TTL Level

General Specifications

Operating Temperature/Humidity: 5°C to 40°C/20% to 80% RH

Warm-up Time: 30 min

Power Requirements: 90 V to 132 V, or 198 V to 264 V, 47 Hz to 66 Hz, 350 VA max.

Size/Weight:

Mainframe: 234 mm H x 426 mm W x 445 mm D (9.36 in x 17 in x 18.2 in)/ 17.0 kg (37.44 lb)

Test Station: 64 mm H x 160 mm W x 160 mm D (2.56 in x 6.4 in x 6.4 in)/ 0.9 kg (1.98 lb)

Key Literature

E4991A RF Impedance/Material Analyzer Technical Overview, p/n 5980-1234E

E4991A RF Impedance/Material Analyzer Data Sheet, p/n 5980-1233E

New Generation Analyzer Offers Exceptional and Powerful Analysis

Functions for RF Impedance Measurement, p/n 5988-0200EN

Advanced Impedance Measurement Capability of the RF I-V Method

Compared to the Network Analysis Method, p/n 5988-0728EN

Achieving Fast Cycle Time Using an Electronic Design Automation (EDA)

Tool and the E4991A RF Impedance/Material Analyzer, p/n 5988-3029EN

Accurate Impedance Measurement with Cascade Microtech Probe

System, p/n 5988-3279EN

Ordering Information

E4991A RF Impedance/Material Analyzer

Furnished Accessories:

16195B 7 mm Coaxial Calibration Kit, Floppy Disk, CD-ROM (Manual), and Power Cable (No test fixture is furnished with E4991A)

Options

E4991A-001 Add DC Bias

E4991A-002 Add Material Measurement Firmware

E4991A-007 Temperature Characteristic Test Kit

E4991A-010 Probe Station Connection Kit

E4991A-800 Standard Frequency Reference, No DC Bias

E4991A-810 Add Keyboard

E4991A-820 Add Mouse

E4991A-1D5 High Stability Frequency Reference

E4991A-ABA US-English Localization

E4991A-ABJ Japan-Japanese Localization

E4991A-1CM Rack Mount Kit

E4991A-1CN Front Handle Kit

E4991A-1CP Handle/Rack Mount Kit

Accessories

16190B Performance Test Kit

16195B 7 mm Coaxial Calibration Kit

16192A Parallel Electrode SMD Test Fixture (up to 2 GHz)

16196A/B/C/D Parallel Electrode SMD Test Fixture (up to 3 GHz)

16197A Bottom Electrode SMD Test Fixture (up to 3 GHz)

16092A Test Fixture (up to 500 MHz)

16200B External DC Bias Adapter (up to 1 GHz)

16453A Dielectric Material Test Fixture (up to 1 GHz)

16454A Magnetic Material Test Fixture (up to 1 GHz)

RF SMD Test Fixtures

The following test fixtures can help you achieve the superior accuracy and measurement repeatability you need to evaluate surface mount devices (SMDs) up to 3 GHz.

16196A/B/C/D Parallel Electrode SMD Test Fixtures

The 16196A, 16196B, 16196C and 16196D are coaxial-structured high performance test fixtures for impedance measurements at frequencies up to 3 GHz. These fixtures are your best choice for the characterization of parallel electrode chip inductors and other passive RF components. The 16196A accommodates SMDs with the size code 1.6 mm x 0.8 mm. The 16196B handles SMDs that have the size code 1.0 mm x 0.5 mm. The 16196C is for size code 0.6 mm x 0.3 mm SMDs.



16197A Bottom Electrode SMD Test Fixture

The 16197A is designed for impedance evaluations of bottom electrode SMDs components up to 3 GHz. This test fixture accommodates various sizes of SMDs; as small as 0.6 mm x 0.3 mm (16197A-001) and as large as 3.2 mm x 2.5 mm.

Key Specifications of Test Fixtures

Type of Fixture	Operating Freq. (typ.)	Operating Temperature Configuration	Applicable DUT Electrode	DUT Size (l x w = mm)
16196A	DC to 3 GHz	-55°C to +85°C	Parallel electrodes	1.6 x 0.8 only
16196B	DC to 3 GHz	-55°C to +85°C	Parallel electrodes	1.0 x 0.5 only
16196C	DC to 3 GHz	-55°C to +85°C	Parallel electrodes	0.6 x 0.3 only
16196D	DC to 3 GHz	-55°C to +85°C	Parallel electrodes	0.4 x 0.2 only
16197A	DC to 3 GHz	-55°C to +85°C	Bottom electrodes	0.6 x 0.3 to 3.2 x 2.5

Key Literature

Accessories Selection Guide for Impedance Measurement, p/n 5965-4792E

Ordering Information

16196A Parallel Electrode SMD Test Fixtures

16196A-710 Add a Magnifying Lens and Tweezers

16196B Parallel Electrode SMD Test Fixtures

16196B-710 Add a Magnifying Lens and Tweezers

16196C Parallel Electrode SMD Test Fixtures

16196C-710 Add a Magnifying Lens and Tweezers

16196D Parallel Electrodes SMD Test Fixtures

16196D-710 Add a Magnifying Lens and Tweezers

16197A Bottom Electrode SMD Test Fixtures

16197A-001 Add 0201 (inch)/0603 (mm) Device Guide Set

E4991A
E4991A-002
16453A
16454A

- **Integrated system for permittivity and permeability measurement from 1 MHz to 1 GHz**
- **Versatile fixtures for substrate materials and toroids**
- **Built-in firmware for direct parameter measurement and easy data analysis**



E4991A System (E4991A, 16453A, and 16454A)

E4991A RF Impedance/Material Analyzer (E4991A-002 required)

The E4991A RF impedance/material analyzers provide an easy and versatile material test solution from 1 MHz to 1 GHz. The analyzers measure impedance accurately and automatically calculate permittivity and permeability data from impedance. Various interchangeable test fixtures, designed specifically to work with the E4991A, let you measure dielectric materials and magnetic materials easily.

16453A Dielectric Test Fixture

The 16453A dielectric test fixture is best used for measuring substrate materials (solid, sheet material samples) less than 3 mm in thickness such as PC boards, substrates, and polymer materials. When used with the 16453A, the firmware (E4991A-002) built into the analyzer automatically calculates permittivity parameters. The flexible firmware also lets you display data as a Cole-Cole plot or find relaxation time.

16454A Magnetic Test Fixture

For permeability analysis, the 16454A magnetic test fixture is designed for testing toroidal-shaped samples up to 20 mm in diameter. An example of suitable materials-under-test is soft ferrite magnetic core. The 16454A comes with different sizes of sample holders for different toroid sizes for maximum flexibility. Built-in firmware (E4991A-002) automatically computes permeability parameters, eliminating cumbersome coil-winding or lengthy calculation.

Temperature Coefficient Testing

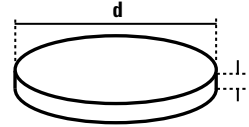
Both 16453A and 16454A have an operating temperature range from -55°C to +200°C. Both test fixtures can be used with E4991A-007, temperature characteristic test kit.

Specifications

E4991A-002

Material Parameters: $|\epsilon_r|$, ϵ_r' , ϵ_r'' , $|\mu_r|$, μ_r' , μ_r'' , $\tan \delta$
Operating Frequency: 1 MHz to 1 GHz

16453A Dielectric Test Fixture



Sample Material Specifications

$t: 0.3 \text{ mm} \leq t \leq 3 \text{ mm}$

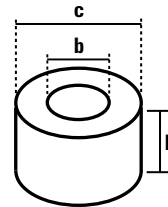
$d: \geq 15 \text{ mm}$

NOTE: Material surface should be flat and parallel.

Operating Frequency Range: 1 MHz to 1 GHz

Operating Temperature Range: -55°C to +200°C

16454A Magnetic Test Fixture



Sample Material Specifications

Fixture Holder	Small A	B	Large C	D
c	$\leq 8 \text{ mm}$	$\leq 6 \text{ mm}$	$\leq 20 \text{ mm}$	$\leq 20 \text{ mm}$
b	$\leq 3.1 \text{ mm}$	$\leq 3.1 \text{ mm}$	$\leq 6 \text{ mm}$	$\leq 5 \text{ mm}$
h	$\leq 3 \text{ mm}$	$\leq 3 \text{ mm}$	$\leq 8.5 \text{ mm}$	$\leq 8.5 \text{ mm}$

Operating Frequency Range: 1 MHz to 1 GHz

Operating Temperature Range: -55°C to +200°C

Key Literature

E4991A RF Impedance/Material Analyzer Technical Overview, p/n 5980-1234E
Agilent Solutions for Measuring Permittivity and Permeability with LCR Meters and Impedance Analyzers, p/n 5980-2862EN

Ordering Information

E4991A RF Impedance/Material Analyzer

E4991A-002 Material Measurement Firmware

E4991A-007 Temperature Characteristic Test Kit

16453A Dielectric Test Fixture

16454A Magnetic Test Fixture

- For measuring capacitance or dielectric constant of solid materials
- Designed for four-terminal-pair LCR meters or impedance analyzers



16451B Dielectric Test Fixture

16451B Dielectric Test Fixture

For dielectric constant evaluation of solid materials such as polymer, electric insulator, PC board, ceramic substrate, etc., use the 16451B dielectric test fixture with any Agilent four-terminal-pair LCR meter or impedance analyzer up to 30 MHz. The 16451B has four types of electrodes which can be replaced according to sample size or measurement technique. Stray admittance and residual impedance of the test fixture can be eliminated by the OPEN/SHORT error correction function of the measurement instrument by using the furnished OPEN/SHORT attachments.

Specifications

Frequency Range: ≤ 30 MHz (depends on instruments)

Operating Temperature: 0°C to $+55^{\circ}\text{C}$

Sample Size: Diameter 10 to 56 mm, Thickness ≤ 10 mm

Parameters: Capacitance, Loss Tangent, ϵ_r' , ϵ_r'' (must be calculated using external computer or IBASIC)

Electrical Interface: Four-terminal pair

Key Literature

Agilent Solutions for Measuring Permittivity and Permeability with LCR Meters and Impedance Analyzers, p/n 5980-2862EN

Ordering Information

16451B Dielectric Test Fixture

- For measuring capacitance or dielectric constant of liquids
- Designed for four-terminal-pair LCR meters or impedance analyzers

16451B

16452A



16452A Liquid Test Fixture

16452A Liquid Test Fixture

For convenient testing of liquids, use the 16452A liquid test fixture with any four-terminal-pair LCR meter or impedance analyzer. With the 16452A, you will be able to measure permittivity and impedance characteristics of liquid materials like plastic resins, or petrochemical products. The fixture has inlet/outlet ports which allow continuous measurements of liquids flowing in a process monitoring environment. The internal cell allows accurate measurements to be performed on a small amount of liquid samples.

Specifications

Operating Frequency: 20 Hz to 30 MHz

Operating Temperature: -20°C to $+125^{\circ}\text{C}$

Sample Size: 3.4 ml to 6.8 ml

Parameters: Capacitance, Loss Tangent, ϵ_r' , ϵ_r'' (must be calculated using external computer or IBASIC)

Electrical Interface: Four-terminal pair

Key Literature

Agilent Solutions for Measuring Permittivity and Permeability with LCR Meters and Impedance Analyzers, p/n 5980-2862EN

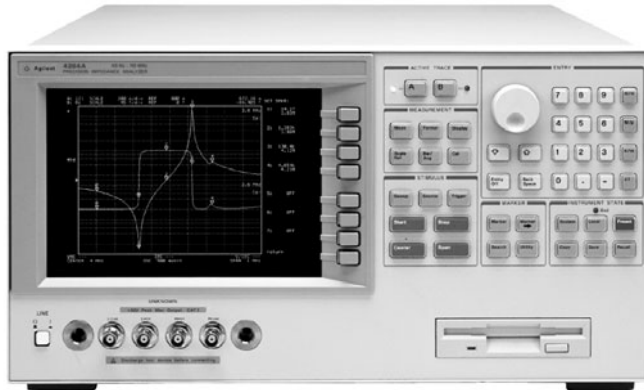
Ordering Information

16452A Liquid Test Fixture

Recommended measurement cables for connecting the 16452A to an Agilent four-terminal-pair LCR meter or impedance analyzer: 16048A Test Lead (0°C to $+55^{\circ}\text{C}$), 16452-61601 (-20°C to $+125^{\circ}\text{C}$), or 16048G Test Lead (-20°C to 150°C , only for 4294A)

Note: The 16452A is not capable of measuring salt or ionic solutions, or other liquids with bulk conductivity due to the electrode polarization phenomenon.

- Accurate measurement over wide impedance range and wide frequency range
- Basic impedance accuracy: $\pm 0.08\%$
- 40 Hz to 110 MHz, 3 m Ω to 500 M Ω
- Powerful impedance analysis function
- Ease of use and versatile PC connectivity
- 30% typical accuracy range: 3 m Ω (100 Hz to 110 MHz), 500 M Ω (100 Hz to 200 kHz)



4294A

4294A Precision Impedance Analyzer

The Agilent 4294A precision impedance analyzer is an integrated solution for efficient impedance measurement and analysis of components and circuits. The 4294A covers a broader test-frequency range (40 Hz to 110 MHz) with Basic impedance accuracy: $\pm 0.08\%$. Excellent High Q/Low D accuracy enables analysis of low-loss components. The wide signal-level ranges enable device evaluation under actual operating conditions. The test signal level range is 5 mV to 1 V_{rms} or 200 μ A to 20 mA_{rms}, and the DC bias range is 0 V to ± 40 V or 0 mA to ± 100 mA. Advanced calibration and error compensation functions eliminate measurement error factors when performing measurements on in-fixture devices. The 4294A is a powerful tool for design, qualification and quality control, and production testing of electronic components. Circuit designers and developers can also benefit from the performance/functionality offered.

Wide-Range Accurate Measurement

The 4294A enables impedance measurement using the auto-balancing bridge technique over the frequency range 40 Hz to 110 MHz. The basic impedance accuracy is $\pm 0.08\%$, and the typical Q accuracy is $\pm 3\%$ @ Q = 100, ≤ 10 MHz. This advantage permits accurate evaluations of impedance characteristics for a wide variety of electronic devices as well as electronic and non-electronic material within a wide frequency range.

Versatile Analysis

The 4294A graphically displays impedance measurement results. This permits easy analysis of the resonant frequency and impedance values of electronic components using the marker functions. The marker functions offer a simple method to pinpoint the resonant frequency of components, as well, these functions assist users in many other observations. The combination of the accumulate mode (to superimpose traces) and the list sweep functions permits observation of the change in a DUT's characteristics due to a change in the measurement condition. Versatile and high-speed automatic testing is possible using the list sweep function in conjunction with the limit line function. The list-sweep function provides the ability to enhance test throughput by segmenting the sweep to include only necessary measurement frequencies, while the limit-line function (for Go/No-Go Testing) provides the ability to apply test limits within each segment. These functions greatly support the quality and performance required evaluating modern and improved electronic components, equipment and materials.

Equivalent Circuit Analysis

The equivalent-circuit analysis function provides advanced modeling (three and four element models) based on circuit constant values of five available circuit models. This function simulates the frequency characteristics of components by using derived circuit values or user-specified values. Comparison of design values to measurement values can assist with efficient component design.

Programming

Full programmability is provided using built-in Instrument (IBASIC). Desired measurements and computations, including graphics analysis, can be programmed simply by storing front-panel keystroke operations. The one-key execution function allows easy selection and execution of customized IBASIC programs. Several forms of storage are built-in (10 Mbyte non-volatile memory, RAM disk or Floppy Disk).

Good PC Connectivity

Features fit to the latest PC environment include LAN (Local Area Network) capability, VGA monitor output, and the TIFF file format. LAN capability permits simplified networking ability when collecting, sharing and analyzing data. VGA monitor output improves productivity and reduces eyestrain. TIFF file format allows easy transfer of graphics to a PC.

Abundance of Accessories

Various Four-terminal-pair test fixtures can be used with the 4294A. The 42941A impedance probe kit (1.5 m), which covers 40 Hz to 110 MHz, enables in-circuit impedance measurement of electronic circuits or components. Grounded devices can also be measured. The 42942A terminal adapter, which covers 40 Hz to 110 MHz, converts the 4-terminal-pair port configuration to a 7 mm test port. This adapter permits the use of familiar 7 mm test fixtures. Again, grounded measurement is available.

Specifications

Measurement Parameters:

$|Z|$, $|Y|$, θ , R, X, G, B, Cp, Cs, Lp, Ls, Rp, Rs, D, Q

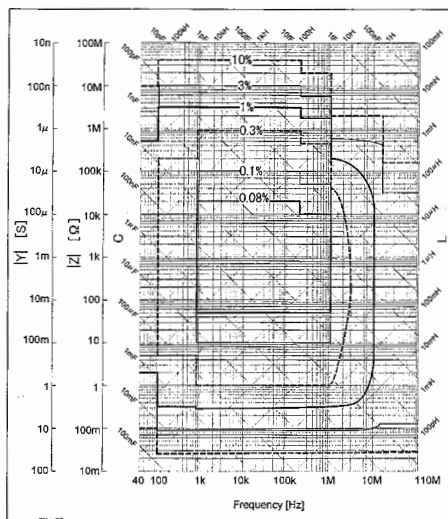
Basic Measurement Accuracy

Basic Impedance Accuracy (4 Terminal Pair): $\pm 0.08\%$

(See figure in detail)

Basic Impedance Accuracy with 42941A: $\pm 0.8\%$ (typical)

Basic Impedance Accuracy with 42942A: $\pm 0.6\%$



4294A Impedance Accuracy @ 4-Terminal-Pair, OSC = 0.5 V

Source Characteristic

Test Frequency: 40 Hz to 110 MHz

Frequency Resolution: 1 mHz

Frequency Accuracy: ± 20 ppm (± 0.13 ppm with 4294A-1D5)

OSC Level: 5 mV to 1 V/200 μ A to 20 mA

OSC Level Resolution: 1 mV/20 μ A

OSC Level Accuracy

Voltage: $\pm((10 + 0.05 * f(\text{MHz}))\% + 1 \text{ mV})$ @ UNKNOWN Terminal OPEN

Current: $\pm((10 + 0.3 * f(\text{MHz}))\% + 50 \mu\text{A})$ @ UNKNOWN Terminal SHORT

Level Monitor Function: Voltage, Current

DC Bias

DC Bias Level: 0 V to ± 40 V, 0 A to ± 100 mA (Auto level control function available)

DC Bias Level Resolution: 1 mV/40 μ A

DC Bias Voltage Accuracy: $\pm(0.1\% + (5 + 30 * I_{\text{mon}}(\text{mA})))$ mV

DC Bias Current Accuracy: $\pm(2\% + (0.2 * V_{\text{mon}}(\text{V})/20))$ mA

DC Level Monitor Function: Voltage, Current

Sweep Characteristic

Sweep Parameter: Frequency, AC voltage, AC current, DC bias voltage, DC bias current

Sweep Type: Linear, Log, List, Zero Span, Manual, Up/Down

Number of Points: 2 to 801

Calibration/Compensation/Adapter Type

Calibration: Open/Short/Load

Compensation: Open/Short/Load, port extension (electrical length)

Adapter Type: None, 1 m, 2 m, 7 mm Adapter (42942A), Probe (42941A)

Display

Size: 8.4 inch

Type: Color LCD (TFT)

Analysis

Marker: 8 markers, delta marker function, search function, analysis function

Equivalent Circuit Function: Approximation, simulation

Others: IBASIC, Limit Line, Accumulate mode

Interface

LAN Interface: 10 Base-T Ethernet, RJ45 Connector, TCP/IP

Other Interface: GPIB Interface, Printer (Centronics), 8 bit I/O, 24 bit I/O, VGA monitor output

Storage

Type: Built-in 3.5 inch floppy disk drive, 10 Mbyte non-volatile memory, 512 kbyte volatile RAM disk memory

Disk Format: DOS

Programming: IBASIC

General Specifications

Operating Temperature and Humidity: 0°C to 40°C, 15% to 80% RH

Power Requirements: 90 V to 132 V, or 198 V to 264 V, 47 Hz to 63 Hz, 300 VA Max.

Size: 222 mm H x 426 mm W x 502 mm D (8.88 in x 17.04 in x 20.08 in)

Weight: 25 kg (55 lb)

4294A Material Solution

The dielectric constant of a solid material can be measured with the 16451B dielectric test fixture. The magnetic constant of toroidal core can be also measured using the 16454A magnetic material test fixture with the 4294A/42942A configuration.

In both applications, the dielectric or magnetic constant is calculated from measured impedance value. The measurement sequence of impedance measurement, material constant calculation and data analysis can be automatically executed using built-in IBASIC programming function.

The measurement program is provided as a sample programs in the 4294A operating manual. Users need to learn the IBASIC programming first, then the program can be modified as they like. The electronics knowledge is required to use these fixtures, because it is basically an impedance measurement.

16451B Frequency Range when used with 4294A: 40 Hz to 30 MHz

16454A Frequency Range when used with 4294A: 1 kHz to 110 MHz

Applicable Material Size: See page 264.

Key Literature

4294A Precision Impedance Analyzer Technical Overview, p/n 5968-3808E

4294A Technical Specification, p/n 5968-3809E

Reliable Electronic Component Evaluation and Circuit Design with the 4294A, p/n 5968-4505E

New Technologies for Accurate Impedance Measurement (40 Hz to 110 MHz), p/n 5968-4506E

Evaluation of MOS Capacitor Oxide C-V Characteristics Using the Agilent 4294A, p/n 5988-5102EN

Accurate Impedance Measurement with Cascade Microtech Probe System, p/n 5988-3279EN

Ordering Information

4294A Precision Impedance Analyzer

Furnished Accessories: floppy disk, CD-ROM (Manual), and power cable. (No test fixture is supplied with the 4294A.)

4294A-1D5 Add High-Stability Frequency Reference

4294A-800 Standard Frequency Reference

4294A-810 Add Keyboard

42941A Impedance Probe Kit

42942A 7 mm Terminal Adapter

42942A-700 Add 7 mm Open/Short/Load set

16047E Test Fixture for axial lead components

16034G SMD Test Fixture

16044A Kelvin Contact SMD Test Fixture

16048G 1 m Cable

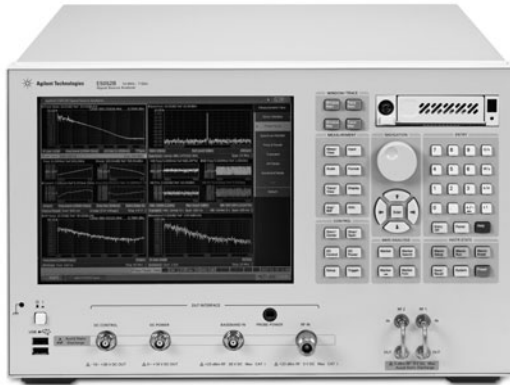
16048H 2 m Cable

16451B Dielectric Material Test Fixture

16454A Magnetic Material Fixture (used with 42942A)

E5052B

- 10 MHz to 7 GHz RF test frequency range (up to 110 GHz with external down-converters and harmonic mixers)
- True single-connection to dramatically simplify signal source evaluations
- 1 Hz to 100 MHz phase noise analysis offset frequency range
- Easy one-step measurement with unparalleled phase noise sensitivity and exceptional measurement speed
- Complete set of transient measurements to fully characterize time response of hopping signal sources and PLL
- Independent AM and base-band noise measurement capabilities
- Built-in ultra-low-noise DC sources provide accuracy and flexibility on oscillator characterization
- Internal VBA® programming for simple and easy automated measurements



The E5052B Signal Source Analyzer is a single-instrument solution that offers an indispensable set of measurement functions for evaluating RF & microwave signal sources such as VCOs, crystal oscillators, SAW oscillators, dielectric resonator oscillators, YIG oscillators, PLL synthesizers, RFICs, and LO circuits.

Applications include mmW signal source characterization with external mixers and precise clock jitter measurement for high-speed digital communication systems and components.

For phase noise, jitter or PM noise, AM noise, low frequency base-band noise measurements, the E5052B offers fast spectrum analysis at logarithmic frequencies up to 100 MHz maximum. Precise and detailed clock jitter analysis for high-speed data communication systems can be done, as well as for traditional low noise signal sources.

For frequency, power, and phase measurements, it has a complete set of test conditions both for statistic and transient characterization, as well as a spectrum monitoring function.

Superior measurement results are achieved by using built-in low-noise reference local oscillators and an innovative cross-correlation technique with two independent internal measurement channels. Thanks to built-in low-noise DC voltage sources the E5052B produces accurate and reliable VCO/PLL tests.

Offering extremely high sampling rate and fine frequency resolution in its transient measurements, which satisfy test needs of fast switching synthesizers for current and future wireless communications and aerospace & defense applications.

This all-in-one solution is designed to provide a significantly accurate and efficient measurement environment with easy-to-use features and excellent PC connectivity in order to improve design and test productivity in signal source engineering.

Select your desired frequency band and connect your signal source. The instrument is set-up automatically and you are ready to measure your DUT.

Specifications

Phase Noise Measurement

Parameters

L(f) single-side-band (SSB) phase noise spectrum density
Residual PM or FM or RJ (random jitter) in user specified bandwidth

RF Input Carrier Frequency Range

10 MHz – 7 GHz (–26.5 GHz with the E5053A)

N(f)-type 50 ohm input connector

RF Input Level

–20 dBm to +20 dBm (–15 dBm to +20 dBm @10 MHz – 30 MHz)

Offset Frequency Range

1 Hz – 100 MHz (10 Hz – 100 MHz for option 011)

Residual Noise Floor: –178 dBc/Hz with built-in low noise reference LO's.

Enhanced Phase Noise Sensitivity

"Cross-correlation method" can improve phase noise sensitivity up to 20 dB (except option 011)

Measurement Speed

0.3 sec per sweep @1 kHz – 100 MHz offset freq. range

13 sec per sweep @1 Hz – 100 MHz offset freq. range

AM Noise Measurement

RF Input Carrier Frequency: 60 MHz – 7 GHz (–26.5 GHz with the E5053A)

RF Input Level: –20 dBm to +20 dBm

Offset Frequency Range: 1 Hz to 40 MHz (10 Hz – 40 MHz for option 011)

Base-Band Noise Measurement

Frequency Range

1 Hz – 100 MHz (AC coupled) [E5052B]

10 Hz – 100 MHz (AC coupled) [E5052B-011]

BNC 50 ohm input

Frequency, Power, and DC Current Measurement

Parameters: Frequency, tuning sensitivity, frequency pushing, RF power level, DC power supply current

Frequency Resolution: 10 Hz/1 kHz/64 kHz

Frequency Uncertainty: same as internal time-base (0.5 ppm typ.)

RF Power Level Uncertainty: 0.5 dB to 1 dB

DC Power Supply Current Measurement Range: 0 – 80 mA

DC Power Supply Current Measurement Resolution: 10 μ A minimum

Frequency, Phase, RF Power Over Time (Transient) Measurement

Parameters: Frequency vs. time, phase vs. time, RF power level vs. time

Frequency Transient Range

4.8 GHz max. in wide-band mode (frequency only)

3.125 kHz/25 kHz/200 kHz/1.6 MHz/25.6 MHz/80 MHz in narrow-band mode

Frequency Resolution: 0.0004 Hz min. *

Time Resolution: 8 nsec minimum *

Spectrum Monitoring

RF Input Frequency Range: 10 MHz – 7 GHz

Frequency Span: 15 MHz max. (linear scale of RF input frequency)

Resolution Bandwidth: 1.53 Hz – 400 kHz

Relative Level Uncertainty: 1.5 dB

DC Sources

DC Control Source: –15 V to +35 V, 20 mA output max.

DC Control Source Noise Level: 1 nV_{rms}/Hz @10 kHz typ.

DC Power Supply Source: 0 to +16 V, 80 mA output max.

DC Power Supply Source Noise Level: 10 nV_{rms}/Hz @10 kHz typ.

Front Panel

10.4 inch color LCD (1,024 x 768 res.) display (touch screen)

Removable HDD, 2 USB connectors, Probe power connector (+15 V, –12.6 V, 150 mA maximum), GND terminal

10 MHz Reference Output on Rear Panel

Frequency Uncertainty: 0.5 ppm typ.

Sinusoidal Waveform Level: 2.5 dBm \pm 3 dB typ.

* depending on frequency range and time span

Accessories

E5053A 26.5 GHz Microwave Down-converter
1250-1744 Adapter, 3.5 mm (f) to Type-N (m), DC to 18 GHz
11500E Cable Assembly, 3.5 mm (m) to 3.5 mm (m), DC to 26.5 GHz
41800A Active Probe (–500 MHz)
41802A 1Mohm Input Adapter
11970 Series Harmonic Mixers
11970A 26.5 GHz – 40 GHz
11970Q 33 GHz – 50 GHz
11970U 40 GHz – 60 GHz
11970V 50 GHz – 75 GHz
11970W 75 GHz – 110 GHz
87405B Preamplifier 10 MHz – 4 GHz 24 dB
87405C Preamplifier 100 MHz – 18 GHz 25 dB
82357B USB/GPIB Interface
E5001A SSA-J Precision Clock Jitter Analysis Software



Key Literature & Web Link

Signal Source Analyzer Brochure, p/n 5989-6389EN
 Signal Source Analyzer Data Sheet, p/n 5989-6388EN
 7 Hints for Making Innovative Signal Source Measurements, p/n 5989-1618EN
 E5001A SSA-J Technical Overview, 5989-5040EN

www.agilent.com/find/ssa

Ordering Information

E5052B 10 MHz to 7 GHz Signal Source Analyzer
 E5052B-011 Delete Functions
 E5052B-1A7 ISO 17025 Compliant Calibration
 E5052B-A6J ANSI Z540 Compliant Calibration
 E5052B-1CM Rackmount Kit
 E5052B-1CN Front Handle Kit
 E5052B-1CP Rackmount and Front Handle Kit
 E5052B-810 Add Keyboard
 E5052B-820 Add Mouse
E5053A 3 GHz to 26.5 GHz Microwave Downconverter
 E5053A-1A7 ISO 17025 Compliant Calibration
 E5053A-1CM Rackmount Kit
 E5053A-1CN Front Handle Kit
 E5053A-1CP Rackmount and Front Handle Kit
 E5053A-ABA Add English Manual Set
 E5053A-ABJ Add Japanese Manual Set
E5001A-1FP E5001A Jitter Application – Standard Tier, Fixed, Perpetual License

E5052B

35670A Dynamic Signal Analyzer

270

Two- or Four-Channel Dynamic Signal Analyzer 35670A

- 100 kHz bandwidth
- Two or four channels (optional)
- 1600 line frequency resolution
- 16-bit ADC/90 dB dynamic range (typical)
- 16 MB RAM Standard
- Integrated source



35670A

3

35670A Dynamic Signal Analyzer

The 35670A lets you make laboratory-quality measurements in the field, on an automobile test track, flying above a city, or in the narrow confines of a submarine. Small enough to fit under an airplane seat, the 35670A is a two-, or four-channel (35670A-AY6), FFT-based spectrum/network analyzer. The standard instrument provides spectrum, network, time-domain, and amplitude-domain measurements from virtually dc to slightly over 100 kHz. Your ability to solve problems in the field is enhanced with the optional four-channel 35670A – measure noise at multiple locations inside vehicles, make triaxial vibration measurements, or gather data from several locations along a noise transmission path.

With the 35670A, you carry all your measurement and analysis tools in one package. Octave analysis (35670A-1D1) adds real-time measurements of 1/1, 1/3, or 1/12 octave spectra at frequencies up to 40 kHz. Computed order tracking (35670A-1D0) allows you to view spectra as a function of orders, or to view the amplitude of multiple orders as a function of RPM. Standard 16 MB of memory provides deep transient time capture or extra space for 2 MB of non-volatile memory. An arbitrary source (35670A-1D4) lets you test devices with real-life test signals. With Instrument BASIC (35670A-1C2), you can automate measurements or customize your instrument interface. Everything you need to troubleshoot vibration and noise problems in the field is in one instrument. (You can retrofit all options – buy only the functionality you need today and add more as your needs change.)

A deep transient time capture memory can record up to four channels of data plus a tachometer signal for playback in the narrow-band FFT, octave, order, correlation, or histogram instrument modes. Pre- and post-trigger delay functions let you capture the leading edge of one-time events or eliminate transmission delay in signals.

Real-Time Octave Analysis to 40 kHz (ANSI S1.11-1986)

Octave analysis (35670A-1D1) adds a real-time octave analyzer to your 35670A for analysis in 1/1-, 1/3-, or 1/12-octave bands. Four LEMO connectors with power for microphones are provided by the microphone adapter and power supply (35670A-UK4). The 1/1- and 1/3-octave band filters in the 35670A comply fully with ANSI S1.11-1986 (Order 3 Type 1-D), DIN 45651, and IEC 225-1966. An overall total power band and an A-weighted overall power band can be activated as needed. All three octave band modes and the overall power band can be A-weighted with an analog filter in full compliance with IEC 651-1979 Type 0. The overall power band can be redefined as a broadband impulse detector that complies with IEC 651-1979 Type 0. A fan-off mode eliminates instrument noise from measurements. A pink noise source allows you to evaluate electroacoustic devices.

View Spectra in the Order Domain (35670A-1D0)

View spectra as a function of orders or track up to five orders on four channels simultaneously with computed order tracking (35670A-1D0). Orders as high as 200 can be tracked. An order map can be displayed as a function of RPM or time, using the waterfall function. Waterfall markers let you view the track of any order.

Computed order tracking is ideal for troubleshooting rotating machinery. Run-up or run-down measurements can be displayed in bode or polar formats. Oscilloscope-quality orbit diagrams are another benefit. Because the data is resampled with changes in RPM, a single-loop orbit display is maintained as the shaft RPM is varied. With four channels (35670A-AY6), two orbits can be measured simultaneously—at both ends of a shaft, for instance. An RPM measurement readout, available in any instrument mode, aids in the interpretation of measurement data from rotating machinery.

Computed order tracking provides alias-protected measurements without expensive and cumbersome external ratio synthesizers and tracking filters. This new technique uses a digital tracking algorithm that follows rapid changes in shaft RPM without time delay and eliminates the phase noise normally associated with ratio synthesizer techniques. Accuracy is enhanced over traditional methods.

Swept-Sine or Broad Measurement Range (35670A-1D2)

The swept-sine instrument mode expands the network analysis range of the 35670A to 130 dB. Higher noise rejection and accuracy are obtained by auto-ranging the instrument during the sweep. Automatic sweep resolution reduces measurement time without sacrificing accuracy. Alternatively, sweep resolution can be set by the user.

Advanced Modeling and Analysis Cut Design Time

Prototype revisions are reduced by modeling design modifications using curve fit and synthesis functions (35670A-1D3). In a typical application, a model of the test device is created by curve fitting a frequency response measurement. Up to 20 poles and 20 zeros are used to describe the device; results can be output in pole/zero, pole/residue, or polynomial formats. The designer then transfers the circuit model to the synthesis function. Using synthesis, the model is modified by adding or deleting poles and zeros. The frequency response function of the modified model is then synthesized to test the design modification.

Automation Improves Productivity

Instrument BASIC (35670A-1C2) replaces the external computer in small test systems. Like the computer, it can be used to automate measurements, create a custom user interface, synthesize new information from raw data, or control other instruments and peripherals. An optional external keyboard plugs into the rear panel. The 35670A provides direct control of external disks, plotters, and printers via GPIB RS-232, or parallel interfaces, and is fully programmable via the GPIB.

Key Literature

35670A Rotor Dynamics Measurement Technique, p/n 5966-0518E

35670A Technical Data Sheet, p/n 5966-3064E

35670A Product Overview, p/n 5966-3063E

For more information, visit our web site:

<http://cp.literature.agilent.com/litweb/pdf/5966-3064E.pdf>

Ordering Information

35670A Dynamic Signal Analyzer

35670A-AY6 Add 2 Input Channels

35670A-1D0 Computed Order Tracking Measurements

35670A-1D1 Real-Time Octave Measurements

35670A-UK4 Microphone Adapter and Power Supply

35670A-1D2 Swept-Sine Measurements

35670A-1D3 Curve Fit/Synthesis

35670A-1D4 Arbitrary Waveform Source

35670A-1C2 Instrument BASIC

35670A-100 Software Bundle

Accessories

35250A DC Power Cable (3 m)

35251A DC Power Cable w/Cigaretter Lighter Adapter